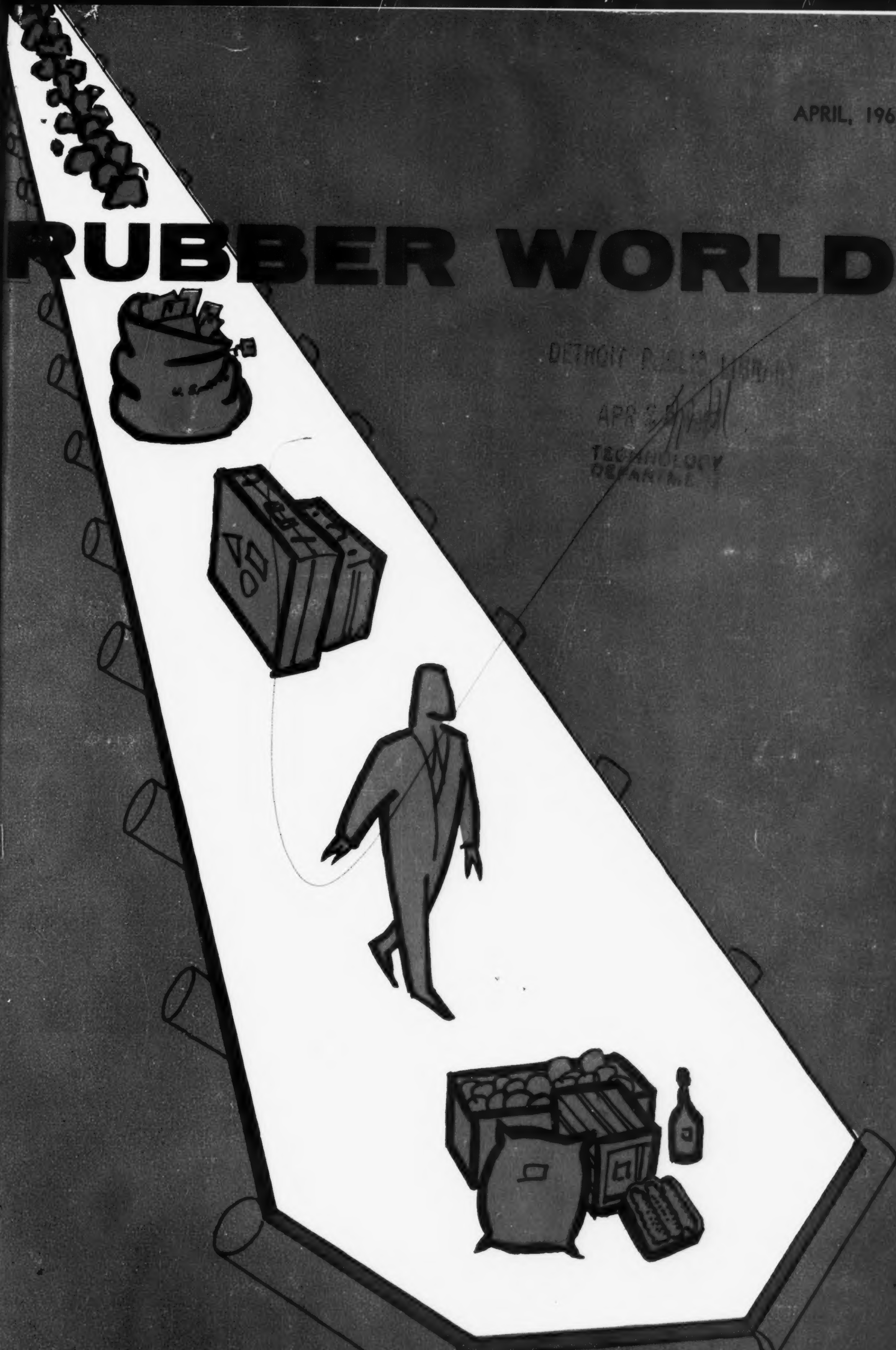
APRIL, 1961

RUBBER WORLD



Conveyors roll into new fields

New Shell Isoprene Rubber. Note the white color. It accounts for exceptional brilliancy in finished products

BULLETIN:

Shell Chemical announces increased production of Shell Isoprene Rubber—and tells how to get immediate shipments of this revolutionary new polymer

Shell Chemical has boosted polyisoprene capacity to over 3,000,000 pounds a month. This means carload lots are now available for immediate delivery.

Here is what you should know about new Shell Isoprene Rubber—the only commercially made polymer to unite the advantages of natural and synthetic rubber.

In 1959, Shell ended industry's 40-year search for a commercially made synthetic that would duplicate the *cis*-polyisoprene structure of natural rubber.

This year, Shell Chemical will be America's sole supplier of *polyisoprene* rubber. Over 3,000,000 pounds can be made a month for use in heavy-duty truck tires, surgical tubing, shoes, bathing caps, toys, rubber thread and hundreds of other products.

Properties never before possible

New Shell Isoprene Rubber possesses properties such as high resilience and low heat build-up that were never before possible in a synthetic polymer. Its mold flow is superior to natural rubber. It is uniform. Its color is *white*. And because Shell Isoprene Rubber is made by a chemically controlled process, it is ideal for items that demand exceptional purity.

Easy to process

This remarkable rubber can be blended with natural and most synthetic polymers in any proportion. And can be processed in conventional equipment.

New Shell Isoprene Rubber's processing characteristics, compounding formulations and vulcanization techniques are all similar to those of natural rubber. It can also be used with the same plasticizers, reinforcing agents, softeners, accelerators, vulcanization ingredients and coloring agents.

Shell Isoprene Rubber is available in carload lots or with mixed SBR loads from Shell's Torrance plant. Firms in the East and Midwest can now buy mixed loads of Shell Isoprene Rubber and various SBR polymers at standard truckload prices.

How to order

To order, call a Shell Chemical sales office in Stamford, Connecticut, DAvis 5-1581; Rocky River, Ohio, EDison 3-0600 or Lakewood, California, SPruce 3-4997.

Samples of Shell Isoprene Rubber and technical information are available. Write, Shell Chemical, P.O. Box 216, Torrance, California.

A Bulletin from

Shell Chemical Company

SHELL

Synthetic Rubber Division

RUBBER WORLD, April, 1961, Vol. 144, No. 1. Published monthly by BILL BROTHERS PUBLISHING CORP. Office of Publication, 3rd & Hunting Park Ave., Philadelphia 40, Pa., with Editorial and Executive Offices at 630 Third Avenue, New York 17, N. Y., U.S.A. Second Class Postage Paid at Philadelphia, Pa., under the act of March 3, 1879. Subscription United States $5.00 per year; Canada $6.00; all other countries $10.00. Single Copies 50¢ in U.S.; $1.00 elsewhere. Address Mail to N. Y. Office. Copyright April, 1961, by BILL BROTHERS PUBLISHING CORP.

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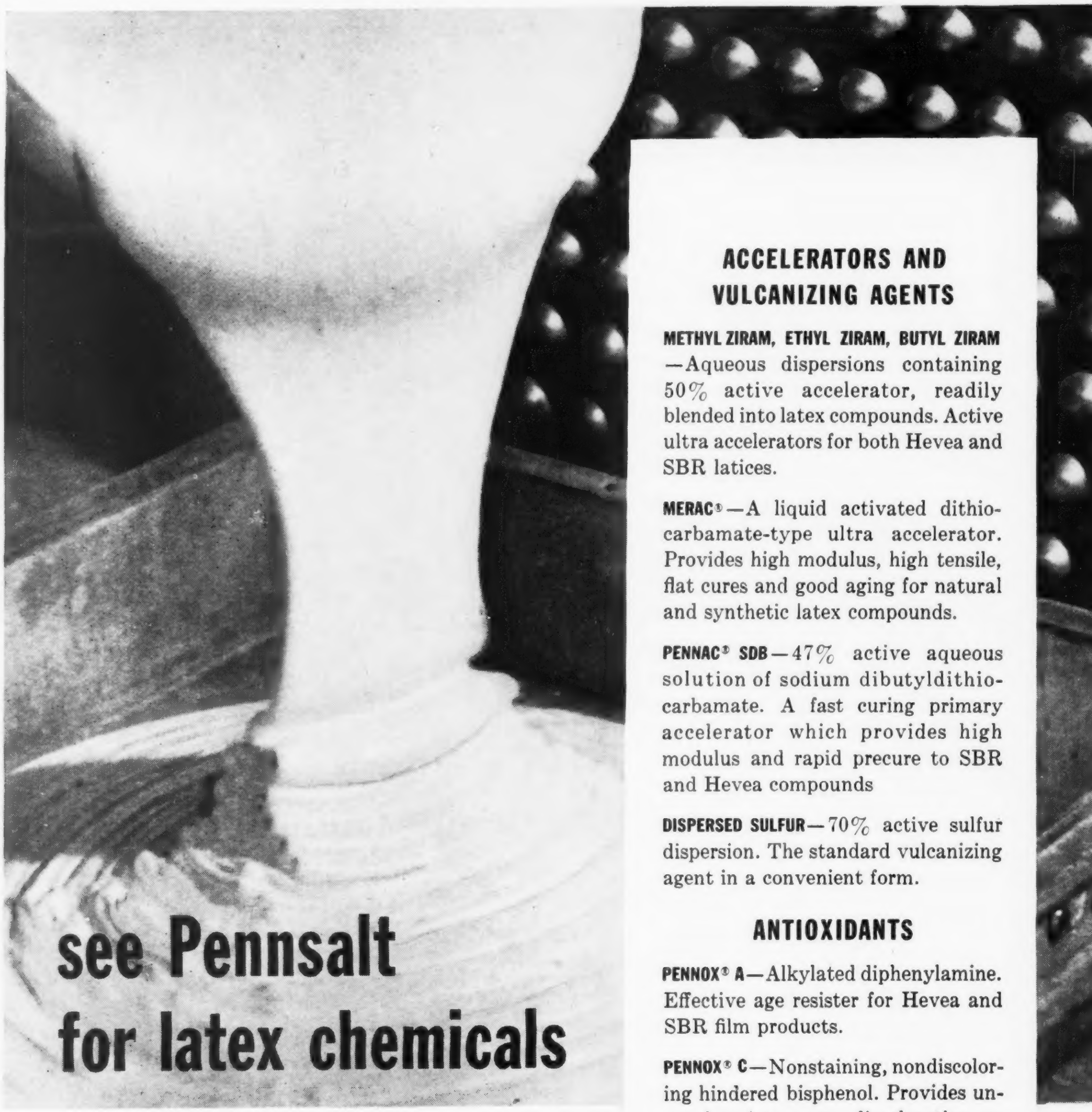
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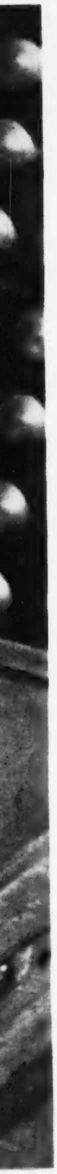
for latex chemicals



ORLD

news of the rubber world

April, 1961

A "Quote of the Month," as selected by H. C. Bugbee writing in the Natural Rubber Bureau's "Natural Rubber News," would seem to bear repeating. In his statement to Linggi Plantations, Ltd., Sir John Hay said, "Accepting the view that the natural rubber industry is entering upon a new phase of more intensified competition with synthetics, I am, nevertheless, confident that the efficient producer can meet such competition and continue to operate profitably." This quote, in Mr. Bugbee's opinion, will be good in 1969 as well as in 1961. It could also be adapted to other segments of the industry.

The General T & R Co. patent for use of oil-extended rubber has been attacked in court. Firestone, not sued by General, has filed suit seeking to have the patent declared void and invalid and ask the court to restrain General from threatening and harassing Firestone and its customers. Joined by The McCreary T & R Co. as a user of Firestone OER, Firestone contends that it purchased rights from the Federal Government under the contract General held for research from 1949 to 1955 and that General's actions violate this contract. This is the first counterattack against the patent although the General suits against Goodyear and U. S. Rubber for infringement are still pending in Federal Court at Cleveland.

Synthetic cis-1,4 polyisoprene can be made to have both the raw and vulcanizate properties of Hevea rubber when made with Ziegler catalysts under conditions which give rise to certain requirements. These requirements, the conditions necessary, and the resulting properties are described in a report, page 69, by B. F. Goodrich on such research. The conclusion drawn is that by using the information described, a synthetic replacement for NR has become a reality.

(Continued on next page)

news of the rubber world

Tire cord continues to make news and to be the subject of a great deal of research. As announced in this column last month, Seiberling has introduced a tire combining rayon and nylon yarn in the same construction. The background on this development will be found on page 81. At the same time, work on upgrading the properties of existing cord materials or finding new cord materials goes on unceasingly. Goodyear is now trying very hard to improve nylon. See page 83.

Production of Diene rubber at Orange, Tex., is announced by Firestone. This is the first tire producer to come on stream with polybutadiene. It thus joins Phillips, with Cis-4, as commercial producers of this type of stereo rubber. World-wide interest in the production of polyisoprene and polybutadiene is very keen. Japanese and Russian firms along with a number of European and South American companies are in various stages of planning or construction of plants to produce one or both of these rubbers. Current status is outlined in a story in News From Abroad on page 106.

Oil-extended polyisoprene, announced recently by Shell, is another development in stereo rubber production which could be the forerunner of quite a few new basic materials for the rubber industry. With natural rubber research looking at the possibilities of oil extending and black masterbatching NR, and the indication that oil-extended polybutadiene and even possibly black masterbatches of BR and IR might not be far behind, the compounder should soon have new areas of economics and technology in his search for better products. The present situation is examined in the Synthetic Rubber Market Review found on page 116.

Conveyor belting, a major industrial rubber product, has been making some very substantial gains over the past few years. These belts are constantly moving into new fields, and some of the developments in construction and materials have been significant, although not too widely known. A special RUBBER WORLD survey gives the inside story on page 76.

Self-bonding silicone rubber is the newest wrinkle in this type of polymer. General Electric announces a new grade that will make good bonds without primers. See page 75.

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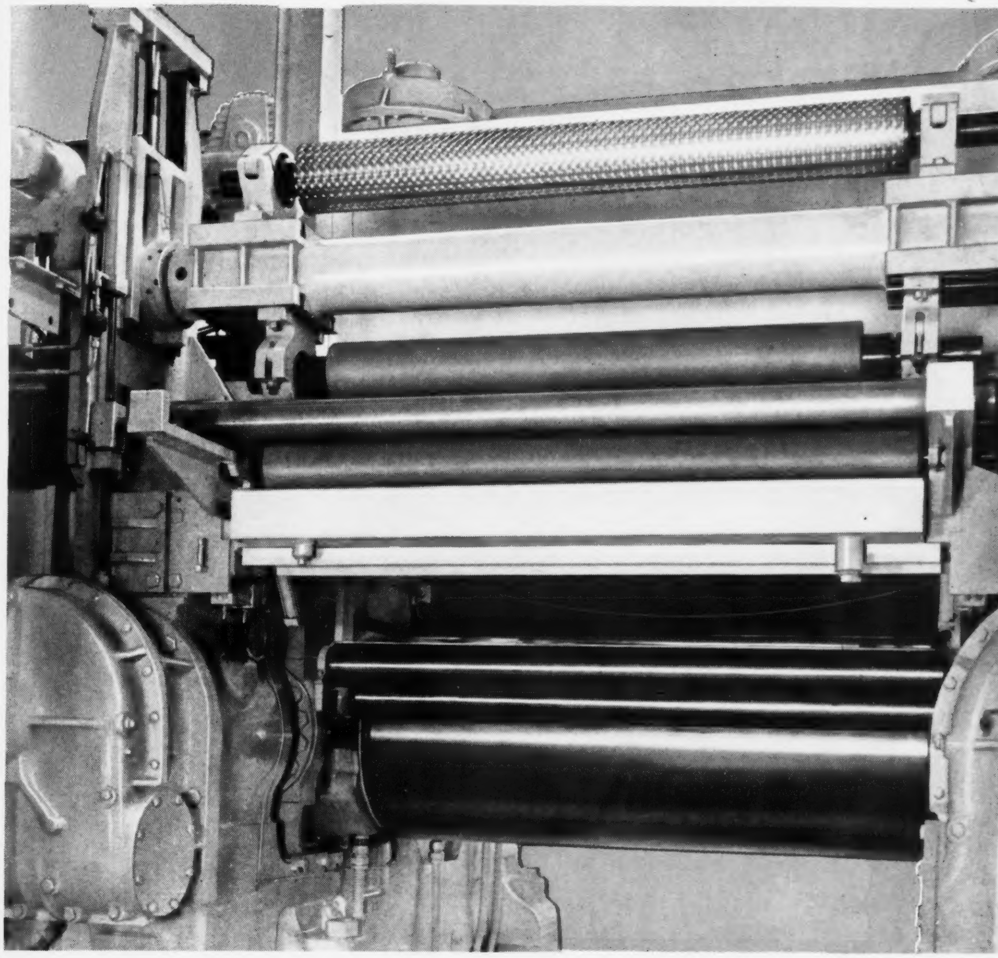


helps level out your quality control line

Another found he could take advantage of the wide range of lasting, light colors PLIOFLEX 1507 permits *and* maintain economical production with a minimum of costly rejects.

A third discovered that PLIOFLEX 1713 could be used in combination with other rubbers to provide the right color characteristics and save several cents per pound!

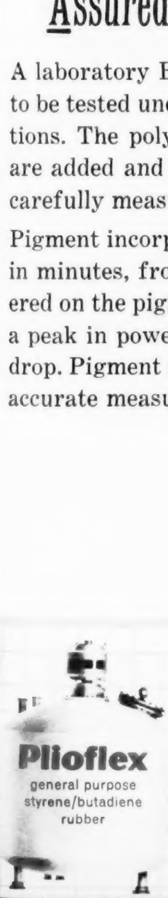
You might benefit in still another way!

How Goodyear determines Assured Processability Factors

A laboratory Banbury is loaded with the polymer to be tested under a specific set of operating conditions. The polymer is masticated. Then pigments are added and the time for their incorporation is carefully measured.

Pigment incorporation is the chart-indicated time, in minutes, from the point where the ram is lowered on the pigment-polymer mix to where there is a peak in power consumption followed by a sharp drop. Pigment incorporation time thus provides an accurate measure of processability.

Plioflex—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio



GOODYEAR

CHEMICAL DIVISION

ROYLE STRAINERS MEAN RUBBER PROFITS

Royle 4A Strainer

As an example—Royle Strainers, with new, quick-opening heads, assure much longer production runs than ever before possible and considerably less down-time.

The large screen area gives more production time between screen changes; while the new breech-lock head, with automatic hydraulic-pneumatic operation allows for quick screen changes.

There are many other practical advantages built right in to Royle Extruders, for instance:

Heavy Duty Gear Case—with self-lubricating, opposed helical gears that were Royle designed and engineered specifically for strainer operations.

Powered Cut-Off Knife—with either rotary or up-and-down motion and adjustable cycling to give variable length products.

Longer L/D Ratios—allow mixing operations to be performed in the extruder. This gives a continuous and, hence, more economical mixing method than other operations.

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Paterson, N. J.

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Refinements in product lines generally move in two directions. The first is to upgrade the properties to broaden the application area and/or improve product quality. The second is to reduce costs. This can be accomplished by improving the processibility of a product.

FEF structure black represents the ultimate in uniformity and processing ease. Advanced engineering and instrumented production techniques ensure this uniformity. Daily quality control laboratory tests evaluating FEF's physical and chemical properties confirm this uniformity. FEF offers unique properties that assure true dimensions and improved appearance in end products.

H. R. BISHOP
Material Control Laboratory
United Carbon Company

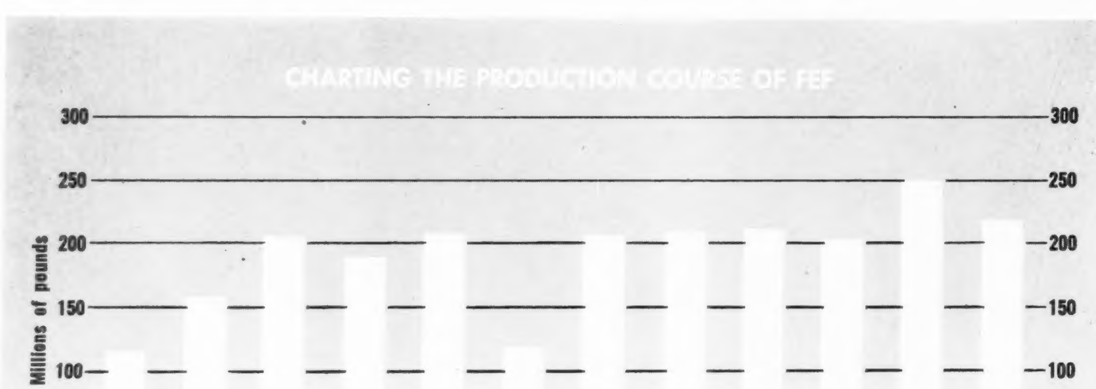
A Product in Perspective

FEF Carbon Black

FEF carbon black, or Fast Extrusion Furnace black, produced by the furnace process from an oil base typifies the nomenclature system devised for carbon blacks by the industry. This material was developed for a single purpose and its name spells it out. Today, the true value of this black far exceeds this one function of fast extrusion, but by and large, its unique role is still as a processing aid.

Reviewing this processibility feature and ascribing it to an inherent value of the black will help explain why this fairly good reinforcing agent is a star. FEF exhibits a chain-like particle alignment. In technical terminology it is a structure black. In fact, it has a higher degree of structure than is present in any conventional grade of rubber black. It is because of this structure that FEF assists by speeding up extrusion, by reducing uncured stock nerve, by retaining gauge and by imparting excellent smoothness to tubed and calendered stocks.

In mixing, it seems to penetrate the rubber stock



Source: Bureau of Mines, U. S. DEPT. OF THE INTERIOR: NGPA.

(Advertisement)

The extrusion process allows almost limitless cross sectional shape possibilities—just a few are pictured above.

more readily and produces uniform mixtures that result in high quality appearance, slick smooth surfaces, delicate feather edges, suppleness and pliability.

The end product will also benefit from the structure of FEF. Less shrinkage will be experienced and thus provide dimensional accuracy, truer gauge extrusions, more accurate moldings and clearer calender impression patterns.

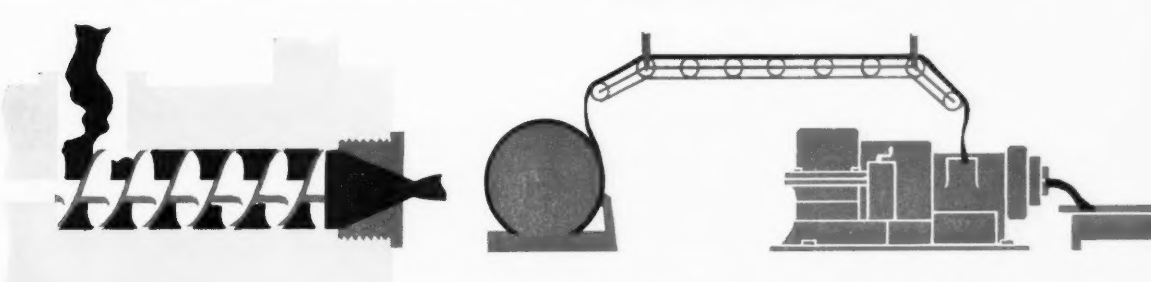
Another value of this unique black is its ability to give a relatively high level of reinforcement without excessive heat build up. In transportation items, this resistance to heat build up improves wear and reduces fatigue.

From a manufacturing standpoint, FEF black is distinguished from other oil-furnace blacks because it requires much more closely controlled oil-to-air proportions and temperature levels. In assessing this black on a comparative basis the functions of carbon black are again presented. They are:

1. Reinforcement (wear and service life)
2. Filler (economy)
3. Processing Aid (mixing and fabrication)

Particle size and surface characteristics of FEF approach more closely those of the lower reinforcing blacks, yet its higher structure allows FEF to excel every other type of black in extrusion or calendering. It does not have the reinforcement qualities of HAF (High Abrasion Furnace) black but it is more economical to use and will give better processing. It processes better than HMF (High Modulus Furnace) black and offers improved strength.

FEF is unmatched as a processing aid. It is compatible with other carbon blacks and is frequently used in combination with them to improve their processing. It is widely used in the preparation of inner tubes and also by the wire and cable industry. When-



FEF carbon black—Fast Extrusion Furnace—is unmatched as a processing aid and excels for extrusion or calendering. The extrusion process is illustrated here, showing a rubber compound feeding into the machine and being forced by a screw through the die which determines the shape and size of the rubber product produced.

ever processing is at a premium, FEF is the natural choice.

Unquestionably, FEF will retain its position as a processing aid in the new rubbers now arising which are, generally speaking, difficult to process.

The unique structure level of FEF carbon black is difficult to achieve and product uniformity can be maintained only through very exact manufacturing conditions.

If you have a particular question relating to FEF or any other carbon black manufactured by United Carbon Company, please write to Dept. RW-4, United Carbon Company, Inc., 410 Park Avenue, New York 22, N. Y.

PROPERTIES OF FEF IN REVIEW

PROPERTIES*	UNITS	HMF	FEF	HAF
Surface Area	Sq. M./Gm.	33.0	39.0	69.2
Partical Dia.	Mu	95.0	80.0	45.2
Volatile Matter	%	0.65	0.91	1.63
Ash	%	0.54	0.11	0.24
PH	—	10.1	9.3	9.2
Iodine Number	Mg./Gm.	40.1	47.0	76.1
Tint Comparison	—	287.	308.	366.

*Property values are based on United Carbon and/or ASTM test procedures. Values given are typical.

This property chart can illustrate in broad comparisons the difference between HMF, FEF, the true carbon black processing aid, and HAF.

UNITED CARBON COMPANY, INC.
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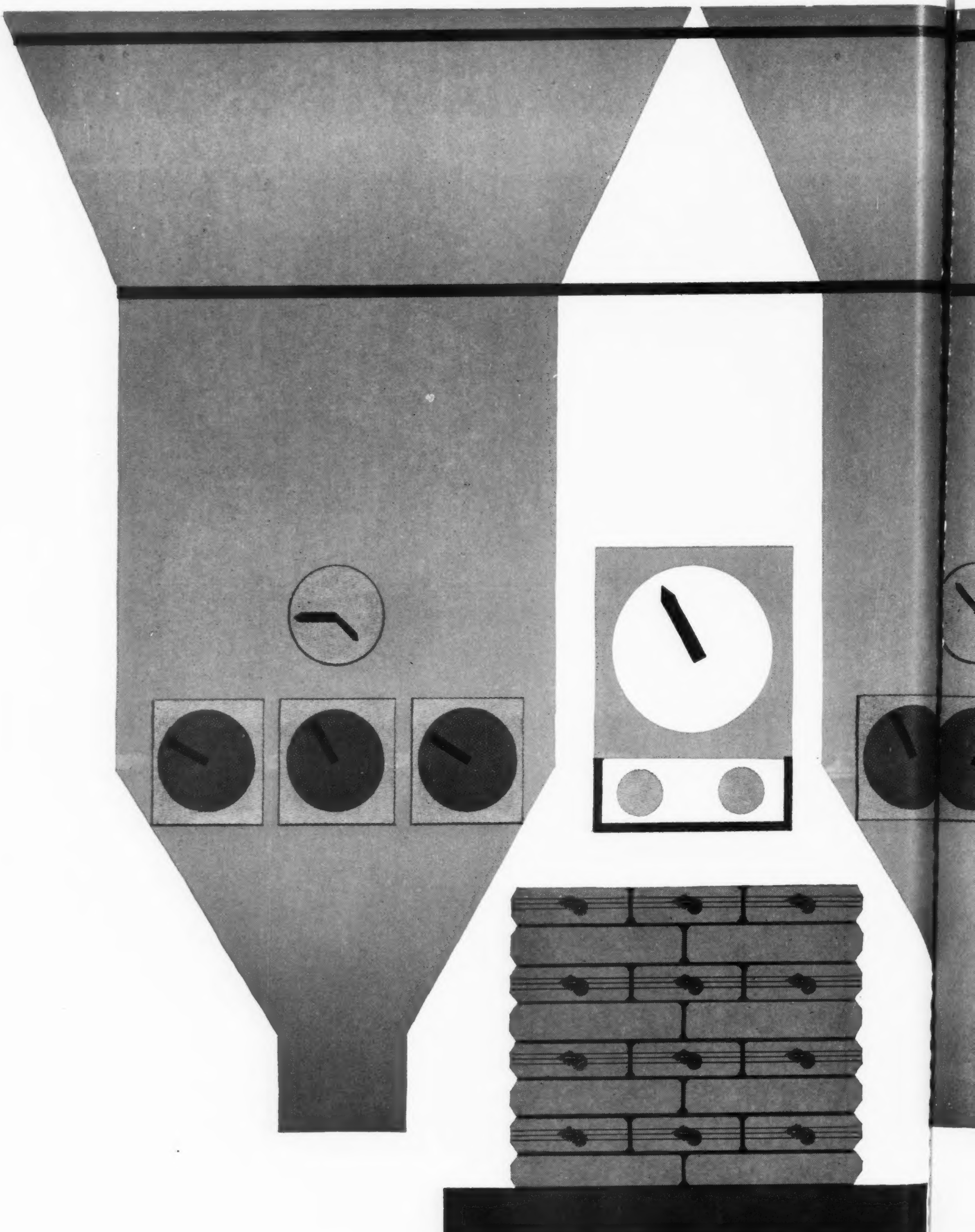

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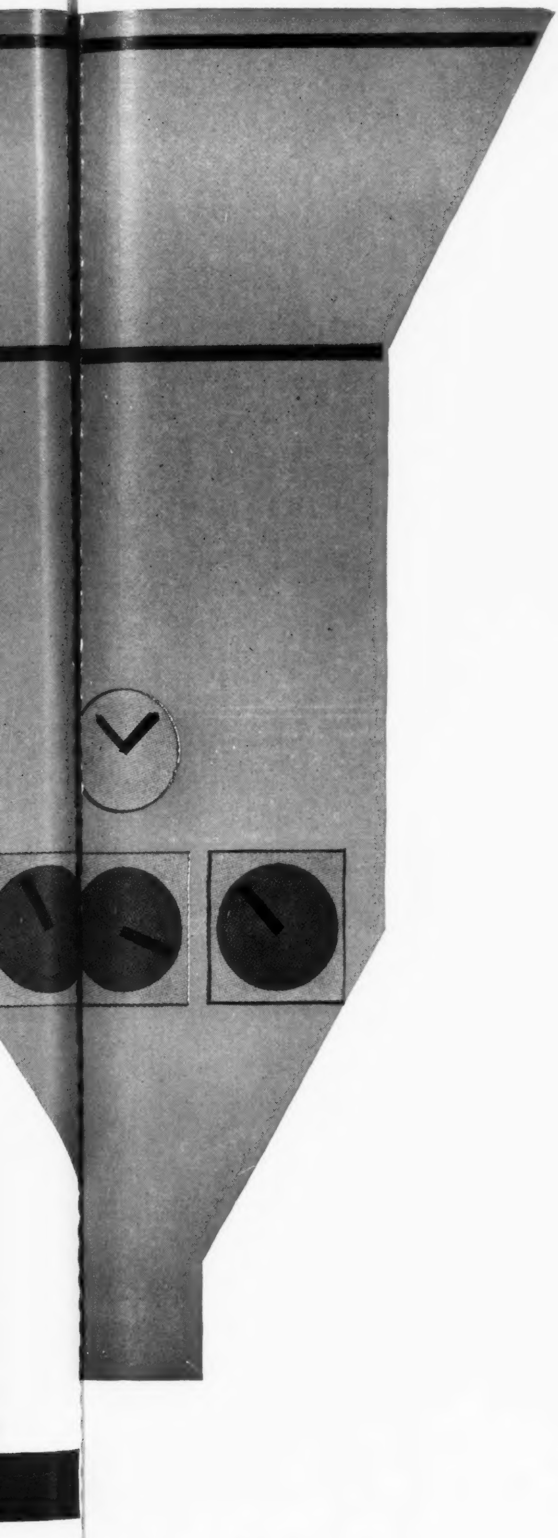

technical books

BOOK REVIEWS

"Synthetic Rubber Technology," Volume 1. W. S. Penn. Cloth, 5¾ x 8¾ inches, 336 pages. Maclaren & Sons, Ltd., London, England. Price $8.50.

The outstanding feature of this book is the fact that it was edited by one man, thus gaining a great deal by its continuity. The order of presentation and a fairly standard sequence of information on each of the rubbers covered give it a definite advantage over other recent books with individual authors for each chapter.

This first volume covers the compounding, processing, and applications of SBR, NBR, silicone rubber, IIR, CR, Thiokol, and high styrene resins. Additional newer rubbers will be handled in Volume 2.

The book starts out with two general chapters. The first covers laboratory procedures, and the second a preliminary guide to the selection of the proper polymer for specific purposes. Following these is a series of chapters for each rubber included. Chapter 3 deals with the nomenclature of the type of rubber; Chapter 4 contains information on general compounding principles, and the following chapters go into detailed compounding, processing, or uses. The number of chapters vary with the amount of use or technology needed for the particular rubber.

This would appear to be a very good book for the younger man in the industry and probably a good refresher reference for all men concerned with rubber technology.

"Bibliography of Rubber Literature for 1955-56." M. E. Lerner, Editor-in-Chief. Published by the Division of Rubber Chemistry, American Chemical Society, Akron, O. Cloth bound, 573 pages. Price $7.50.

This eleventh edition has more than 7,000 references and patent listings, covering 380 pages. References are taken from nearly 500 journals published all over the world.

Listed are articles on such subjects as dry rubbers, latices, compounding and compounding ingredients, carbon black and other reinforcing agents, rubber chemicals, chemistry and physics of rubber, processing operations and equipment, cultivation of natural rubber, rubber testing, rubber-like plastics, rubber as an engineering material, and so on.

The increasing amount of literature in the field is shown by the fact that the first edition of the magazine in 1935 contained only 49 pages of

references. The current edition has 7,000 references over a two-year period, compared with 9,710 references in the three-year 1952-54 edition. The 1957-58 edition, to be out in a few months, will have 8,000 references, and the 1959 edition 5,000 references for one year.

NEW PUBLICATIONS

"Geon Solution Resins." Service Bulletin G-15. B. F. Goodrich Chemical Co., Cleveland, O. 24 pages. This bulletin lists properties and compounding for various applications of Geon vinyl chloride polymers.

"Union Carbide Silicones." Silicones Division, Union Carbide Corp., New York, N. Y. 16 pages. This bulletin describes properties and applications of Union Carbide silicone fluids, resins, rubber compounds, water repellents, anti-foams, and emulsions.

Publications of Naugatuck Chemical, Division of United States Rubber Co., Naugatuck, Conn.:

"Tuex and Ethyl Tuex." Compounding Research Report No. 31-A. 18 pages.

"New Super Dispersing Forms of Butyl Rubber Curatives, GMF-SD and Dibenzo GMF-SD." Bulletin 236. 6 pages.

Publications of The Natural Rubber Producers Research Association, Welwyn Garden City, Herts, England:

No. 362. **"Relative G.L.C. Retention Data Using a Single Standard."** By J. F. Smith. 4 pages.

No. 363. **"Thiols of Low Molecular Weight in *Hevea Brasiliensis* Latex."** By A. I. McMullen. 8 pages.

No. 364. **"Nucleotides of *Hevea Brasiliensis* Latex: The Pyrophosphate Components."** By A. I. McMullen. 4 pages.

No. 365. **"Recent Studies Concerning the Oxidative Aging of Vulcanized Natural Rubber by the Technique of Stress Relaxation."** By J. R. Dunn. 8 pages.

No. 366. **"Analysis of Solubility Data to Estimate Small Amounts of Chain Fracture during the Cross Linking of Rubber."** By L. Mullins and D. T. Turner. 4 pages.

No. 367. **"Longitudinal Wave Propagation in Stretched Polymers."** By P. Mason. 4 pages.

No. 369. **"Some Viscous and Elastic Properties of Rubberized Bitumens."** By L. M. Smith 12 pages.

No. 373. **"An Interpretation of Acceleration by Thiourea and Related Compounds of the Tetramethyl-Thiuram Disulfide Vulcanization of Natural Rubber."** By C. G. Moore, B. Saville, and A. A. Watson.

(*Continued on page 44*)

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VORLD

new materials

■

Pronar Butyl Modifier

American Cyanamid Co., rubber chemicals department, Bound Brook, N. J., has made available a new butyl reaction promoter, Pronar, which, it claims, not only provides economical heat treatment for black stocks, but also for white or light-colored stocks since it is non-coloring and non-staining.

Polyurethane Adhesives

Alco Oil & Chemical Corp., Philadelphia, Pa., has introduced a line of adhesive compounds based on acrylic interpolymer latices which were specifically developed for the binding of polyether or polyester foams to various types of textile fabrics, paper, and metal foil.

The advantages of the adhesives include the fact that there is no foam loss as in fusion processes, no expensive outlay for special equipment, and a more flexible hand for the finished products.

The recommended heating time and temperature is 3 to 10 minutes at 280 to 300° F. All adhesives are applied directly to the polyurethane foam by spraying, roller coating, stripping, or rotogravure printing procedures.

Synpol 8155A

Synpol 8155A, a cold SBR black masterbatch containing 52 parts of ISAF, has been introduced by Texas-U.S. Chemical Co., New York, N. Y.

The product uses a rosin acid emulsion, a staining stabilizer, and acid coagulant. It is recommended for use in tires and mechanical goods where high abrasion is required.

New Release Paper

A new release paper called Stick-Not is being marketed by Crocker, Burbank Papers, Inc., Fitchburg, Mass. Used as a casting paper for calendered rubber, or as an interleaf for rubber blankets, it provides easy release from sticky surfaces and imparts a high, smooth finish to the rubber. The paper has a high tensile and tear strength and can easily be die-cut or printed on the untreated side.

new materials

Ameripol 4664 and 4758

Goodrich-Gulf Chemicals, Inc., Cleveland, O., recently introduced two Ameripols.

Ameripol 4664 is an SBR micro-black masterbatch containing 52 phr. ISAF black. The masterbatch is polymerized with a rosin acid soap and coagulated with acid. It contains a staining antioxidant. It is recommended for tires, tread rubber and belting.

Ameripol 4758 is an oil-extended black SBR masterbatch containing 82.5 phr. ISAF black and 62.5 phr. of highly aromatic oil. The cold SBR is polymerized with a mixed acid emulsification system and contains a staining antioxidant. It is recommended for tread stocks and other applications requiring good abrasion resistance.

Admold Liquid Rubber Latex

Adhesive Products Corp., New York, N. Y., has developed Admold Molding Latex, a material which may be used to produce flexible rubber molds of any object—no matter how many undercuts, projections, or fine details the object may have.

Admold is a one-part compound, requiring no batter mixing of components in order to create the molding material. In its original form it is a milky-white liquid rubber which is self-vulcanizing. When applied to the object to be molded and exposed to air at normal room temperature, the liquid evaporates, leaving a light amber gum-rubber which makes a flexible and durable mold. No catalytic agents or accelerators are required for drying or curing.

Vinyl Copolymer Resins

Thompson Chemical Co., Pawtucket, R. I., has added two vinyl chloride-vinyl acetate copolymer resins to its line of products.

Called Trulon 750 and 760, they are white, dry, free-flowing resins possessing particle size such that 100% will pass through 40-mesh screen, 1.36 specific gravity, and 13-15% vinyl acetate content.

New Line of Plasticizers

Archer-Daniels-Midland Co., Minneapolis, Minn., has added two new low-viscosity monomeric plasticizers to Admex 750, introduced last year.

Admex 752 and 755 are designed to help vinyl compounders meet recently revised automotive requirements which demand absolute minimums in volatility, in addition to excellent low-temperature properties.

(*Continued on page 40*)


Big League

TYPICAL PHYSICAL PROPERTIES

(Based on test recipe of 100.0 parts Ameripol 4604, 40.0 parts EPC Black, 5.0 parts zinc oxide, 1.5 parts stearic acid, 2.0 parts Benzothiazyldisulfide, 2.0 parts sulfur).

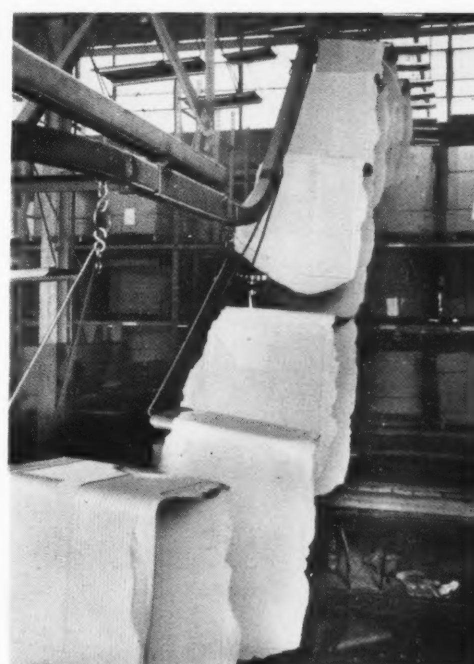
	Cure @ 292°F.	
Raw Viscosity, ML-4 @ 212°F.		40
Compound Viscosity, ML-4 @ 212°F.		51
Tensile, psi	50′	3080
Elongation, %	50′	745
Modulus, 300%, psi	25′	310
300%, psi	50′	830
300%, psi	100′	1260

AMERIPOL 4700 CUTS FLOOR MAT COST

Each one of these automobile floor mats coming down the conveyor line at Anchor Industries, Inc., Cleveland, represents a savings over the previous rubber polymer used.

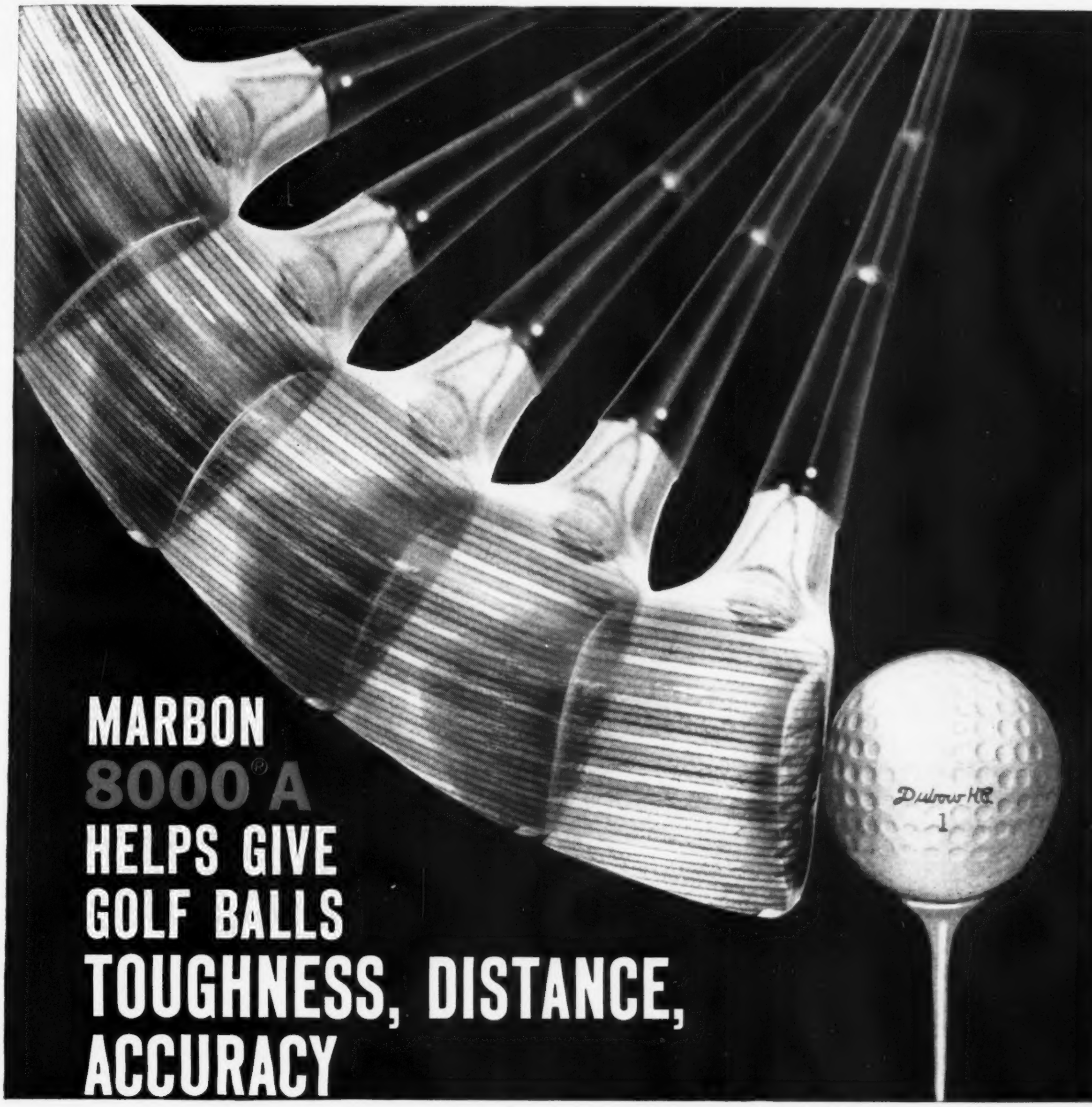
The mats are made from Ameripol 4700, which is a 50-part oil-extended rubber; thus costs substantially less than low-oil polymers. Ameripol 4700 maintains the high quality level this company has established; permits processing in a range of colors.

Since Goodrich-Gulf produces the broadest range of SBR polymers, we are in excellent position to help you in selecting the type which exactly meets your needs.



Goodrich-Gulf Chemicals, Inc.

1717 East Ninth Street • Cleveland 14, Ohio



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Swoo-o-osh! Club head smashes against ball at 80 MPH! This is the vital moment that proves whether a golf ball can take tremendous punishment, drive after drive, and still maintain its durability, impact-resistance and liveliness. Golf ball covers made with Marbon 8000A High Styrene Resins can and do... thanks to the top performance this remarkable rubber-reinforcing material helps build into them. Find out how Marbon 8000A resins can help your product stand up to its moment of truth time after time by giving it greater toughness, durability and resistance to heat and moisture. For further information, write Dept. W-4.

MARBON CHEMICAL DIVISION **BORG-WARNER**
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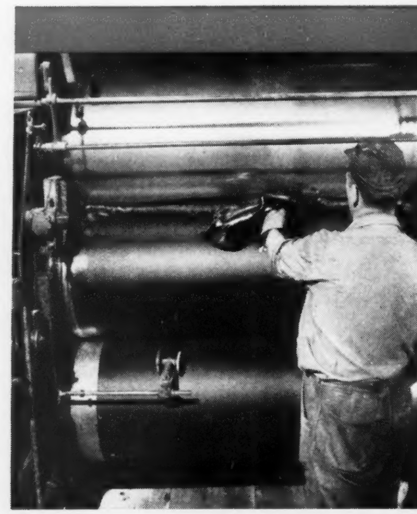

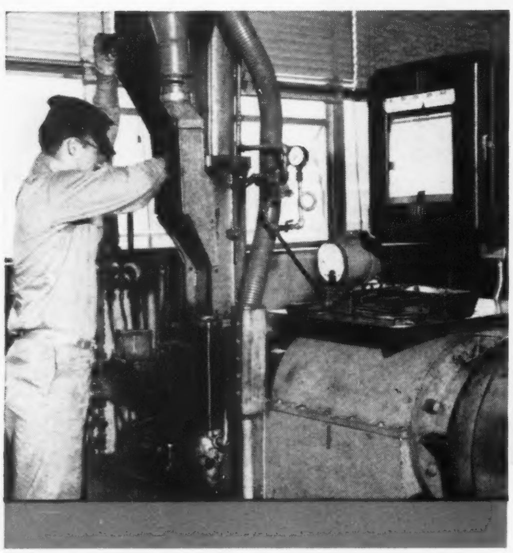

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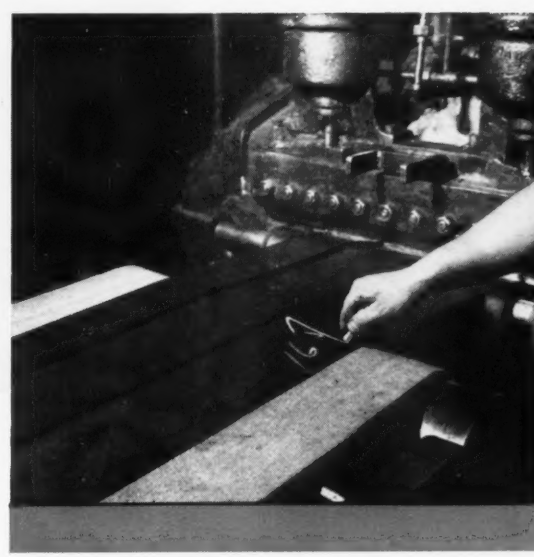
There are Columbian representatives located in these and 35 other countries around the world. To take advantage of Columbian Carbon technical service—no matter where you are located—contact your local Columbian representative.

International distributor: **COLUMBIAN CARBON INTERNATIONAL, INC.**



new materials

(*Continued from page 32*)

Styrene-Maleic Anhydride Resins

Texas Butadiene & Chemical Corp., New York, N. Y., announces the semi-commercial production of a new series of low molecular weight styrene-maleic anhydride resins.

To be marketed under the trade name SMA, these resins are white, free-flowing powders having melting points ranging from 95 to 165° C. and acid numbers ranging from 186 to 500. Because of their short chain polyanhydride structure, they may be used as chemical intermediates, emulsification agents, and pigment dispersants.

Semi-commercial price of these resins is 59¢ a pound of solids in drum quantities, and 57¢ a pound in truckload quantities; less than drum quantities are 75¢ a pound. Projected commercial prices are expected to be in the 50-55¢ a pound range.

Maniflex #744—Foam Binder

A new latex binder for polyurethane and rubber foam is now available from Manufacturers Chemical Co., Inc., Camden, N. J.

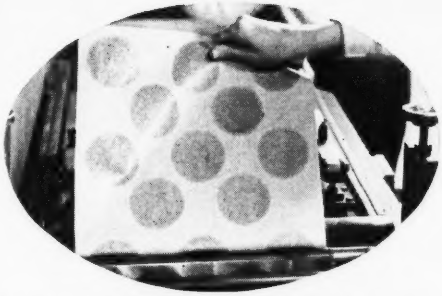
Called Maniflex #744, the new binder has the same polarity as the foam and produces a strong bond through physical-chemical absoption rather than by physical action alone. This binder is applied by standard methods, produces a tight cure at moderate temperatures, is non-flammable, and forms no toxic fumes, the manufacturer says.

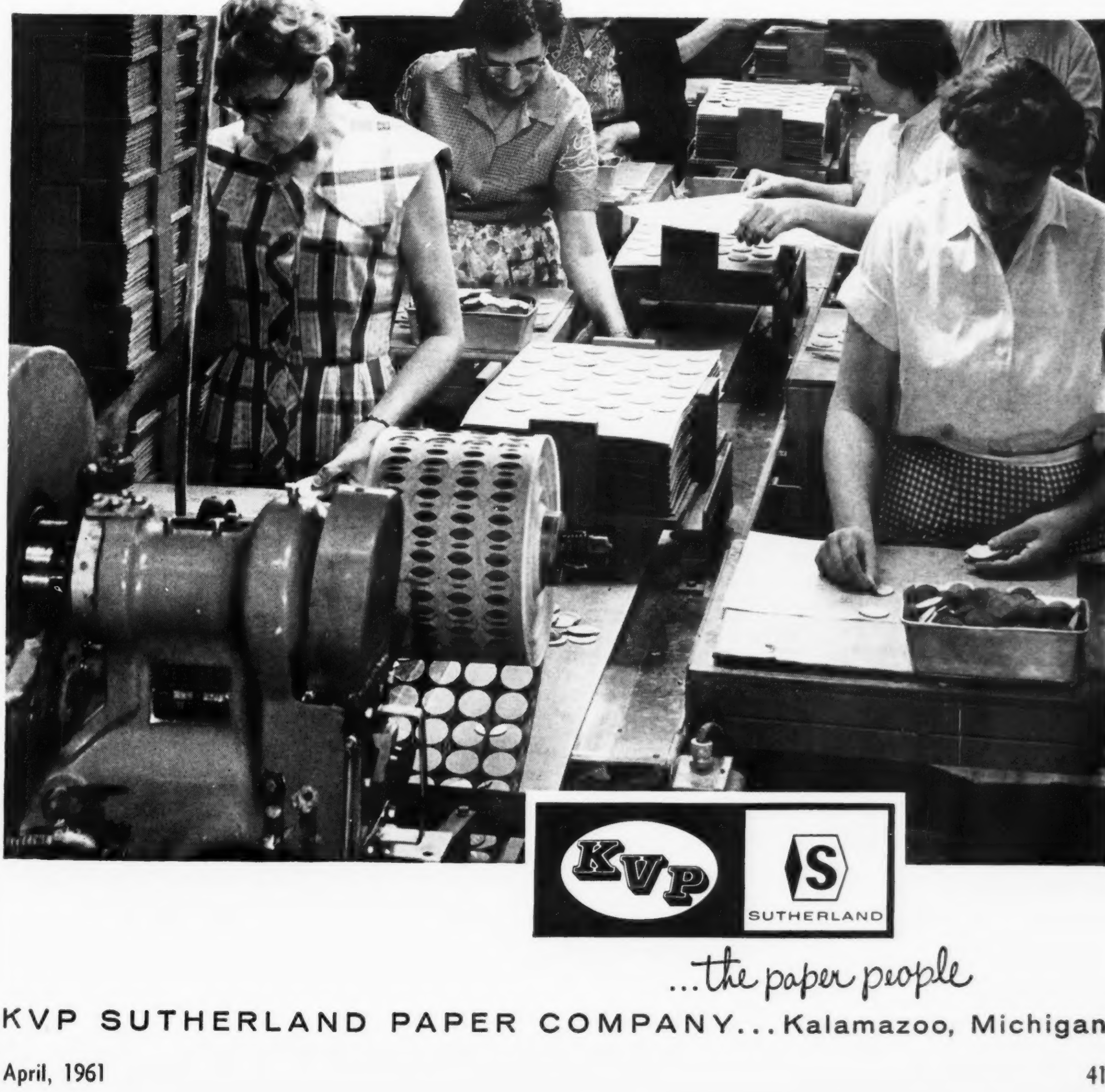
VM&P Solvent 230

Delhi-Taylor Oil Corp., chemical division, Dallas, Tex., is now producing VM&P Solvent 230 at its plant in Corpus Christi, Tex. The solvent is uniform, features high solvency (KB-40) and high flash point (50° F). Its applications include use as a diluent in paint, varnish, protective coatings, and rubber compounding.

Rub-R-Vive, Rubber Plasticizer

A new rubber plasticizer, Rub-R-Vive, that is particularly suited for office, laboratory, shop, and home use, has been announced by Schwartz Chemical Co., Inc., Long Island City, N. Y. The product is non-flammable and non-volatile and is applied with a soft saturated cloth to the rubber surface.





new products

■

Booster Hose

Eureka Fire Hose Division, United States Rubber Co., New York, N. Y., has developed a booster hose claimed to have at least 2½ times the flex life of other hose.

Called the "Firo" high-pressure booster hose, the new product employs a tube of nitrile rubber, which makes the hose serviceable in coldest weather. A black cover of neoprene gives maximum resistance to gasolines, oils, and weathering conditions.

Because of a single braid of high-tensile steel wire in the carcass, the hose is able to withstand test pressures of 2,000 pounds, compared with an 800-pound test rating for ordinary booster hose, the manufacturer says. The wire braid construction also gives resistance to end pull and has sufficient rigidity to resist the kinking and crushing normally encountered in booster hose use.

Natural Rubber Lining

The Goodyear Tire & Rubber Co., Akron, O., has developed a new natural rubber lining material that cold-bonds itself to metal and other surfaces with field-applied cement.

Called Jade Green Armabond, the material is designed to protect interior surfaces of chutes, mills, cyclone collectors, and shot and sand blast machinery against abrasion and chemical action of most inorganic salts, alkalies, and acids. It is also suitable for recapping conveyor belts.

Polypropylene Polymers

Three new polypropylene polymers, two of them meeting FDA regulations for food and drug applications, have been introduced by AviSun Corp., Philadelphia, Pa.

The new food-grade polymers, 4011 for extrusion applications and 4014 for injection molding uses, can be used for extruded squeeze-tube packages, injection molded containers for dairy products and hard foods, vacuum formed containers for disposable blister packages, and boilable food packs.

The high flow injection molding polymer, 1016, is especially designed for high-speed multiple-cavity molding situations, when close shrinkage and warpage control of the molded parts are desired.

PRESSURE PYTHON—Time, always an important factor in the construction industry, figured importantly in the building of a new Princeton, New Jersey housing development. The contractors had to drain a culvert and then build a bridge over it to complete one of the development roadways. Because there was a time limitation involved, it was evident that a pumping process, to clean out the culvert, would have to go on 24 hours a day in order to meet the deadline. The Cordflex suction hose was selected for the round-the-clock task of pumping out the slime and water to clear the way for building the new bridge. This hose was chosen because of its unusual ability to resist pressure, to stand abrasion, and because of its power and stamina for remaining on the job under difficult conditions. The Cordflex hose was made by Acme-Hamilton Mfg. Corp. of Trenton, New Jersey. One of the important materials used in the making of this hose is Mount Vernon duck.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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Mount Vernon Mills, inc.

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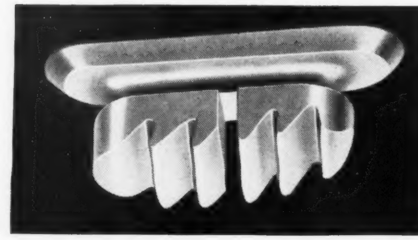
new products



Improved Heel for Walking Casts

New Ripple Heel

A new heel for walking casts has been developed by Ripple Sole Corp., Detroit, Mich., and is being manufactured exclusively by Beebe Rubber Co., Nashua, N. H. This heel gives a cushioning effect to the injured leg by absorbing shocks. Because of its wedge shape, it also eliminates the possibility of its pushing through the plaster against the foot.

■

New Publications

(Continued from page 26)

No. 368. **"The Distribution of Polymethyl Methacrylate Formed in Natural Rubber Latex:** An Electron Microscopical Study." By E. H. Andrews and D. T. Turner. 4 pages.

No. 370. **"Rupture of Rubber."** By H. W. Greensmith, L. Mullins and A. G. Thomas. 12 pages.

No. 371. *Cis-Trans* **Isomerization in Natural Polyisoprenes."** By J. I. Cunneen. 12 pages.

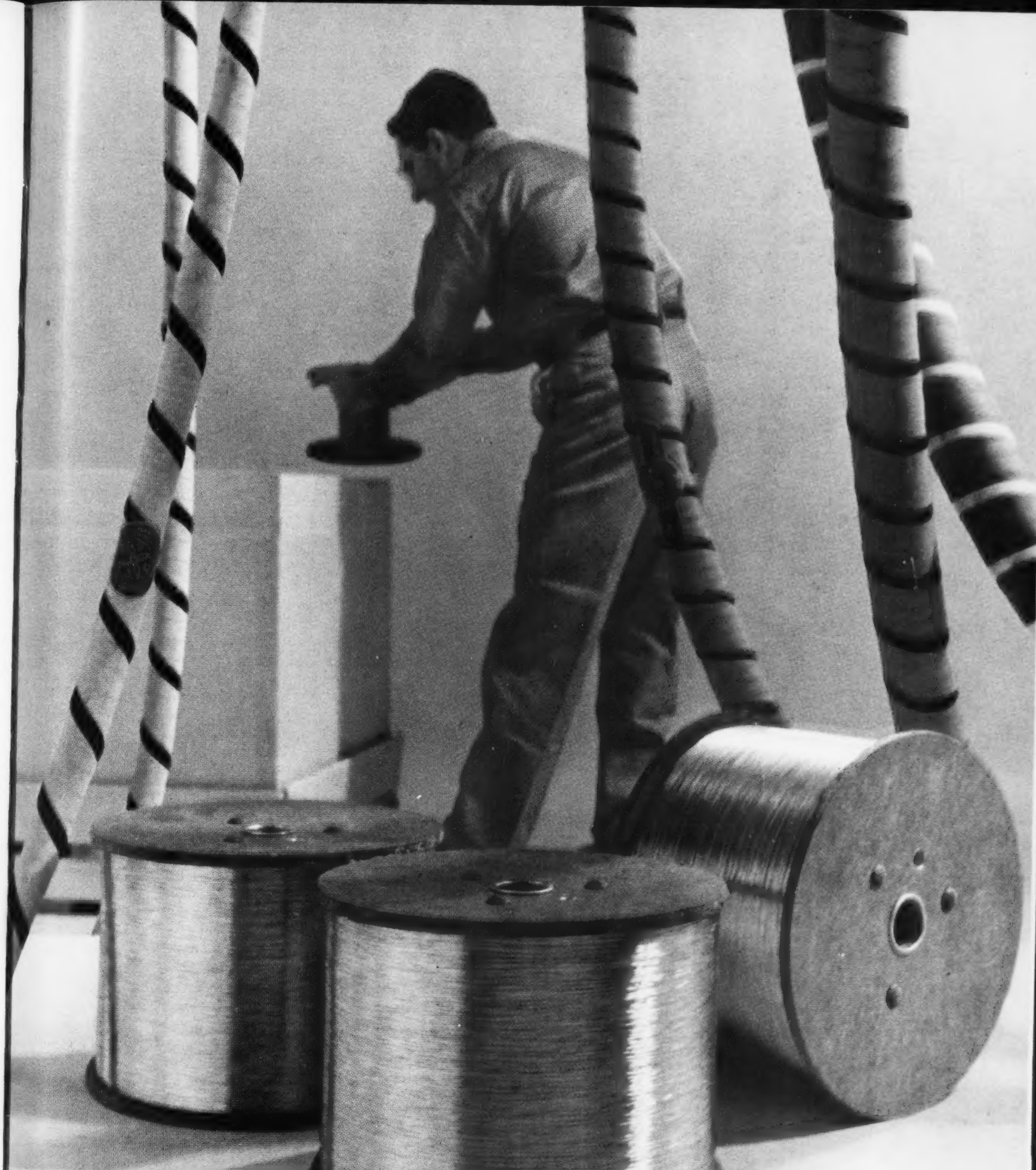
No. 372. **"Reinforcement of Rubber by Fillers Tear Resistance."** By L. Mullins. 12 pages.

"Oil Furnace Blacks for Polysulfide Rubber Compounds." Bulletin CR-13. Thiokol Chemical Corp., Trenton, N. J. 12 pages. This study evaluates five low-structure oil furnace blacks, Cabot Corp.'s Regal 300 and 600 and Columbian Carbon Co.'s Neotex 100, 130, and 150, for use with Thiokol FA and ST polysulfide rubbers, indicating that they give substantially higher tensile strengths, elongation, and tear resistance than obtainable with the commonly used SRF blacks, and without the disadvantages found in use of channel blacks.

"Trolley Conveyors." Bulletin 2730. Link-Belt Co., Chicago, Ill. 58 pages.

"U. S. Government Specifications for Adhesives, Coatings, and Sealers." Minnesota Mining & Mfg. Co., Adhesives, Coatings & Sealers Division, St. Paul, Minn. 54 pages.

"Aroclor Plasticizers." Bulletin PL-306. Monsanto Chemical Co., St. Louis, Mo. 49 pages.



fully automated by *Taylor*

Designed for vulcanizing outsize tires for Aircraft and Earth Moving Equipment, the new Adamson United "squat heater" at The Goodyear Tire & Rubber Company's Akron plant is under completely automatic control.

The operator simply pushes a button to start the cycle. A series of green lights indicate completion of the different phases of the process.

Heart of this control system is a Taylor FLEX-O-TIMER* Time Cycle Controller (surrounded on panel above by graphic representation of the squat heater). This instrument precisely times the entire cure. Cure temperatures, both dome and mold interior, are regulated by Taylor FULSCOPE* Recording Controllers. This fully automatic system gives Goodyear:

Consistent high quality—because cure cycles are uniform.

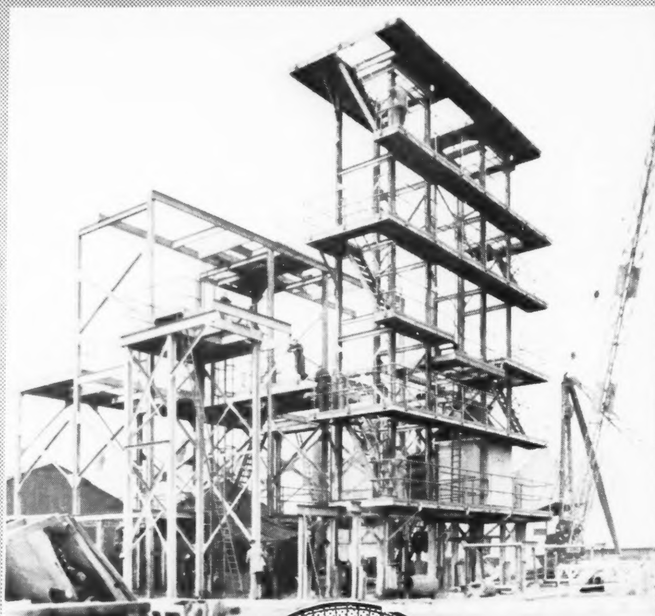
Improved plant efficiency—because it permits closer scheduling of heats, reducing the idle time of equipment and operators.

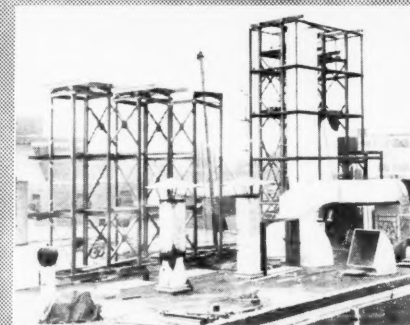
Reduced processing costs—because there's no need for a "steam tender" to time curing stages.

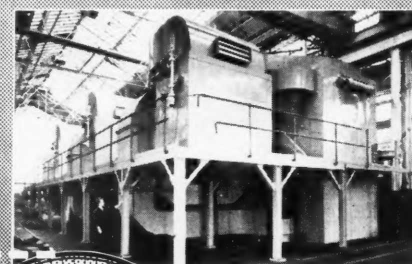
Whenever you are expanding or modernizing, be sure to specify, "Taylor Equipped as Usual." Taylor Instrument Companies, Rochester, N.Y., and Toronto, Ont.

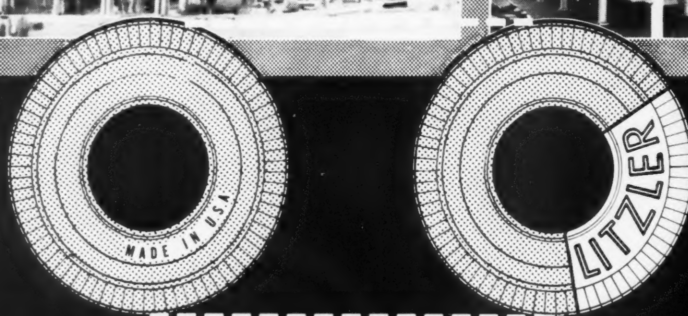
*Reg. U.S. Pat. Off.

Taylor Instruments **MEAN ACCURACY FIRST**









29.5% of existing United States tire cord fabric processing capacity is presently represented by new Litzler fabric treating lines currently under contract. Some are in design phases, others are under construction or undergoing final erection. Some will expand United States production, others are destined for the tire industry abroad, in both hemispheres. Each is a tribute to the capacity of Litzler engineers for truly "Sound Engineering for Tomorrow's Production".

C. A. LITZLER CO., INC.

SOUND ENGINEERING FOR TOMORROW'S PRODUCTION

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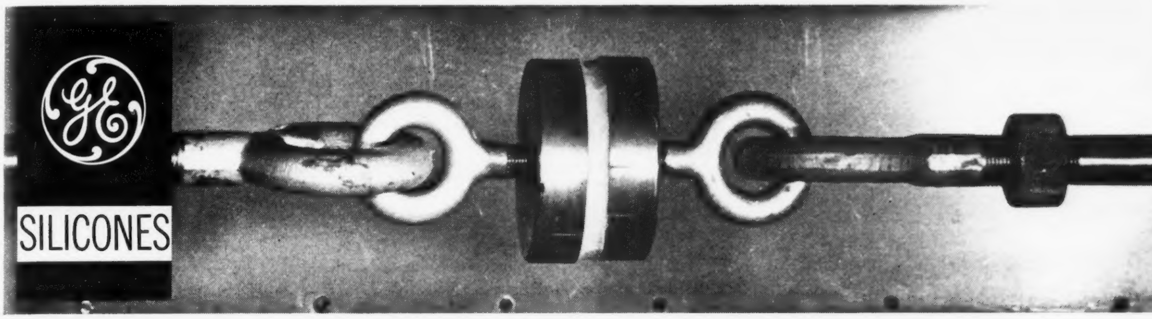
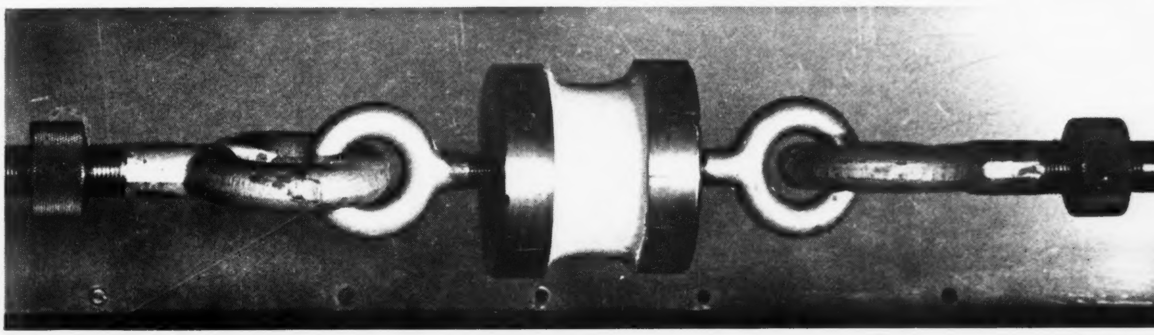
EXPORT REPRESENTATIVE: GILLESPIE & CO. OF N. Y., 2 BROADWAY, NEW YORK 4, N. Y.

LICENSED FABRICATORS: Benno Schilde Maschinenbau A. G., Bad Hersfeld, Germany; Soc. Alsacienne de Constructions Mecaniques, Paris, France; Mather & Platt, Ltd., Manchester, England



New General Electric silicone rubber bonds



to many metals without a primer - the bond is stronger than the rubber!

Here is the final proof of the bonding strength of General Electric's new self-bonding rubber. This high strength rubber was pulled apart at over 1500 psi, but the bond remains intact. The rubber never parted from the steel.

Cuts out half the steps in bonding process

Shown above is General Electric's new high strength self-bonding rubber in action: Without using a primer you can bond this rubber to steel and many other metals so well that the bond is stronger than the rubber itself! SE5504 is one of the strongest silicone rubbers available.

With new SE5504, you can now cut your bonding process in half, by eliminating these four steps: Grinding or sandblasting metal; detergent washing; primer application; oven cure for primer.

Now, you just: Wash metal with solvent; apply self-bonding SE5504; oven cure the rubber. That's all.

This new rubber virtually eliminates rejects due to poor bonding. You speed up production, increase profits, and provide a better product for your customers.

For all the details on new self-bonding SE5504, along with application data, write: General Electric Company, Silicone Products Dept., Section II445, Waterford, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

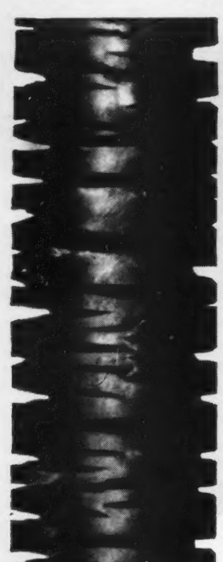
how to vastly increase the useful life of rubber...

Effect of Curing System on Antiozonant Retention in SBR Stocks after Vulcanization

(All contain 3.0 phr UOP 88; 40.0 phr HAF black)

Compound	Accelerator	Sulfur, phr	% Extractable Antiozonant
1082....	2.0 phr benzothiazyl disulfide	2.0	66.4
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1087....	None	2.0	∼100.0
1088....	1.0 phr benzothiazyl disulfide	3.0	74.6
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1089....	1.0 phr benzothiazyl disulfide	1.0	88.6
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1084....	1.0 phr N-cyclohexyl-2-benzothiazole sulfenamide	—	—
1093....	1.0 phr diphenylguanidine	2.0	∼18.0
1085....	2.0 phr tetramethylthiuram disulfide	—	35.0
1090....	4.0 phr tetramethylthiuram disulfide	—	12.9

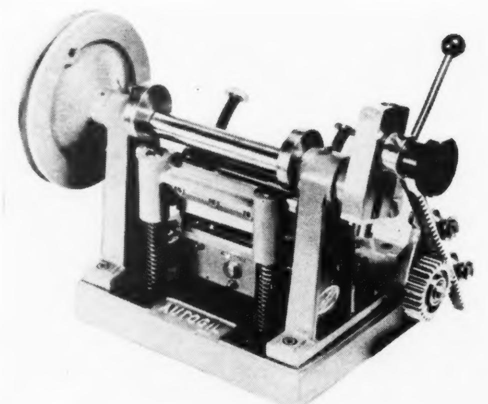
The SBR specimens below were exposed to ozone at 100°F with 20 percent elongation for 52 hr. at 33 pphm ozone, then 187 hr. at 63 pphm ozone.



Carbon black—HAF (high abrasion furnace), Curing system—4 phr tetramethylthiuram disulfide; Hours to first crack—7 to 23.

Carbon black—HAF (high abrasion furnace), Curing system—2 phr sulfur, 1 phr N-cyclohexyl-2-benzothiazole sulfenamide. No cracks in 239 hr.

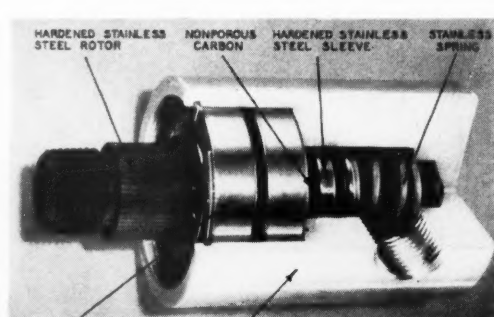
new equipment



Hobbs improved guillotine

Type HS Autogil Cutter

Hobbs Mfg. Co., Worcester, Mass., has announced a new addition to its line of guillotines. The Model 4 Type HS Autogil is designed for rapid production of any length pieces of material up to web widths of four inches maximum. Operating at 300 cuts per minute, the unit will cut lengths ranging from $\frac{1}{16}$-inch to four inches.



A new type of revolving joint is being marketed by Rotherm Engineering Co., Inc., Chicago, Ill. Capable of handling 500 pounds of air or hydraulic pressure with a minimum of turning torque at speeds around 1,500 rpm., the joint possesses a stainless-steel rotor and a non-porous carbon seat that will aline itself to the face of the rotor.

ADAMSON UNITED

PRECISION CALENDERS

Whether the project calls for supplying all mills, calenders, presses and associated machinery for a completely new and modern rubber or plastics plant, or a single unit for a new process, you'll find Adamson United equipment offers the most efficient design and up-to-date operating features for today's production requirements. Our full line of modern rubber and plastics calendering equipment is an outstanding example.

Adamson calenders are skillfully engineered for production of close tolerance, high quality material at high speed. Standard sizes range from 8" x 16" laboratory models to large production units with rolls measuring 36" x 92". Various types include 2, 3 and 4 rolls; vertical, 120 degree, inverted-L, Z-type, cascade, inclined and others. The unit illustrated is a 3-roll, 120-degree, connecting gear-type calender equipped with roll crossing. Adamson calenders are also available with such precision operating features as roll bending, zero clearance, flood lubrication, drilled rolls, anti-friction bearings and pinion-stand drive.

With a complete line of accessory equipment for continuous processing, Adamson United is prepared to handle any rubber or plastics calendering problem you may have. Our engineering staff is at your service — to recommend the unit best suited to your needs, or to develop special equipment to meet your specific requirements. Write or call for complete details — without obligation.

ADAMSON UNITED COMPANY

730 CARROLL STREET, AKRON 4, OHIO

Subsidiary of United Engineering and Foundry Company

Plants at Pittsburgh, Vandergrift, Wilmington, Youngstown, Canton

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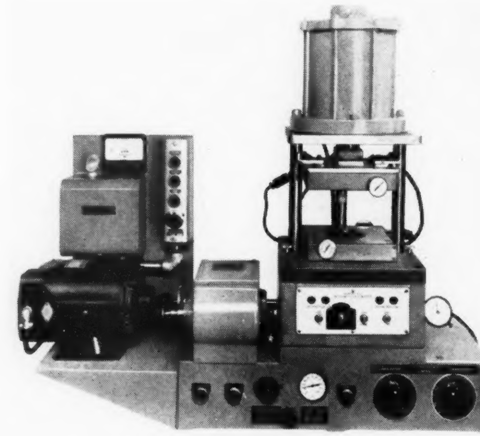
new equipment



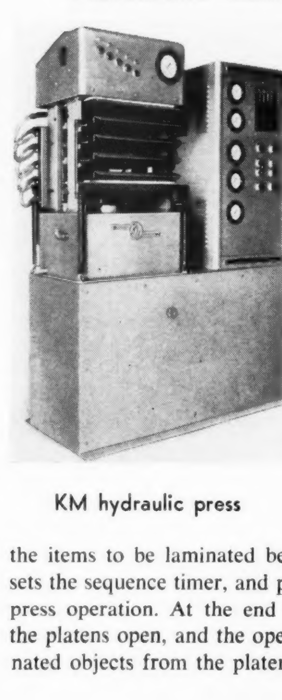
Measures viscosity at different rates of shear

Model STI Shearing Disk Viscometer

Scott Testers, Inc., Providence, R. I., has developed the Model STI shearing disk viscometer, which measures viscosity at different rates of shear.

A modification of the Model STI Mooney viscometer, the new equipment contains a variable speed drive which permits measurement of viscosity at shear rates from 0.05 to 20 rpm. and has a convenient tachometer to aid in rate setting.

Automatic Laminating Press



KM hydraulic press

Kingsbacher Murphy Co., Los Angeles, Calif., has constructed a hydraulic laminating press which consists of press frame and platens, motorized hydraulic unit, and control panel.

The motorized hydraulic unit is controlled by push-buttons found on the control panel. The complete time sequence for laminating can be preset by a sequence timer. The operator inserts the items to be laminated between the platens, presets the sequence timer, and presses a button to begin press operation. At the end of the operating cycle, the platens open, and the operator removes the laminated objects from the platens.

NAUGATUCK FLEXZONE 3-C

ANTIOZONANT-ANTIOXIDANT

NOW USE FLEXZONE 3-C MORE WIDELY

We have just switched production from small-scale quantities to a new large plant. Cost reductions should encourage broader usage in new applications.

FLEXZONE 3-C provides outstanding resistance to:

- **ozone and weather cracking**
- **oxygen and heat**
- **flex cracking**
- **copper deterioration**
- **groove cracking and cut growth**

FLEXZONE 3-C is:

- **in easy-to-disperse flake form**
- **relatively non-migratory and non-volatile**
- **effective in natural and SBR**
- **not adversely affected by carbon blacks, plasticizers, accelerators, or other normal compounding ingredients.**

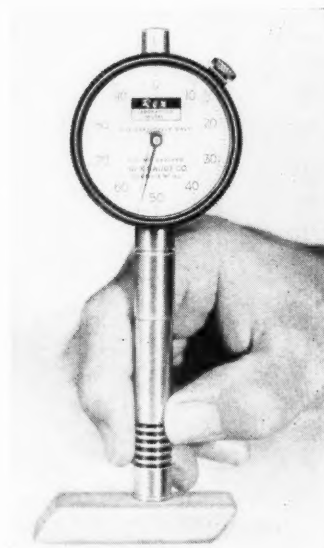
Enjoy the protection only FLEXZONE 3-C offers... at a new lower price. For further information contact your Naugatuck representative.

Naugatuck Chemical

Division of United States Rubber Company 410R Elm Street, Naugatuck, Connecticut

Rubber Chemicals · Synthetic Rubber · Plastics · Agricultural Chemicals · Reclaimed Rubber · Latices · CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario · CABLE: Rubexport, N. Y.

new equipment



Rex Gauge Co., Inc., Glenview, Ill., has introduced its Model 1600 rubber hardness gage. Hardness of rubber and elastomers is measured by holding the gage in vertical position and pressing down until entire foot encounters specimen. Reading is given to plus or minus ½ durometer point.

Rock-Dust Batching Scale

A rock-dust batching scale has been developed by Thayer Scale Corp., Pembroke, Mass., which is expected to have application in phosphate rock, cement, kaolin, pumice, and related mineral industries.

With a capacity of 40 tons of rock dust per hour at an accuracy of ± 1/10 of 1%, the B18R unit consists of a special rotary feeder and a Flexure-Plate scale which supports a tipping weight bucket. The flexure plate eliminates knife-edge pivots and other friction surfaces which would be subject to wear.

New Commercial Blendor

The Model CB-4 Waring commercial blendor has been introduced by Testing Machines, Inc., Mineola, N. Y., for laboratories, hospitals, and industry. Its ability to mix, blend, puree, and liquefy chemicals, foods, and concentrates makes it useful for laboratory work, the company claims. A heavy-duty motor provides easy handling of viscous ingredients over long sustained periods. Stainless-steel blades and clamp are included as standard equipment.

(Continued on page 60)

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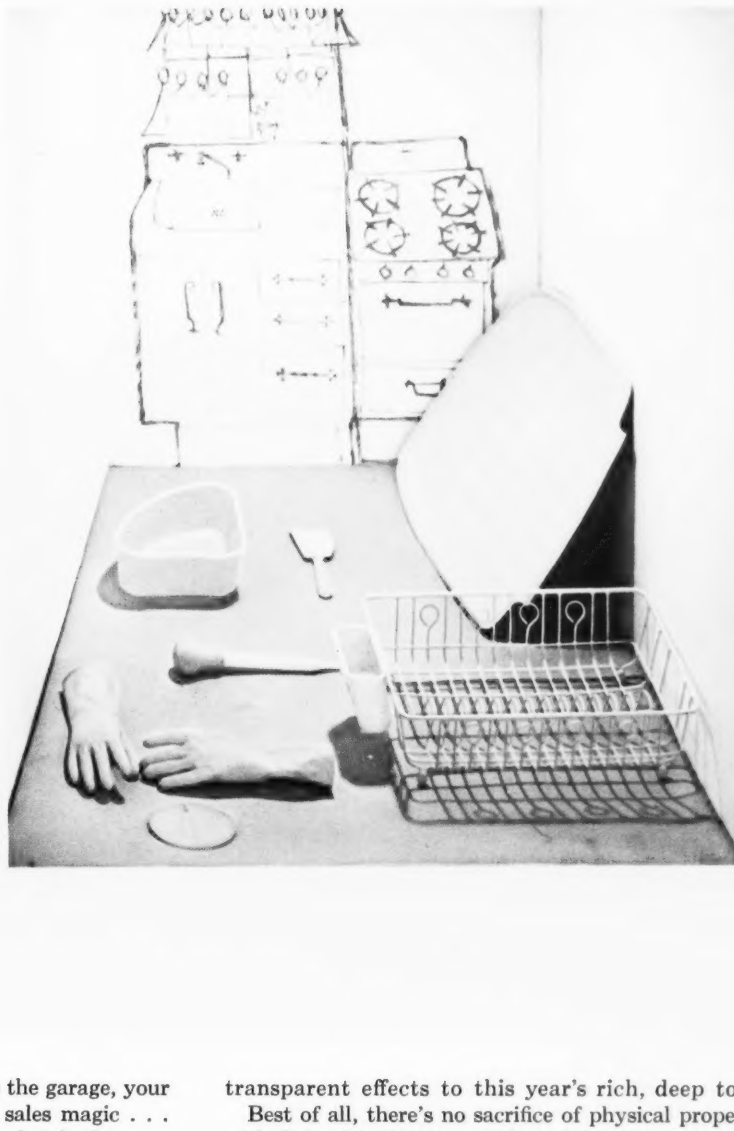
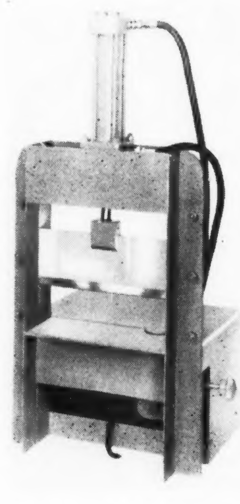


new equipment

(Continued from page 56)

New Bale Cutters



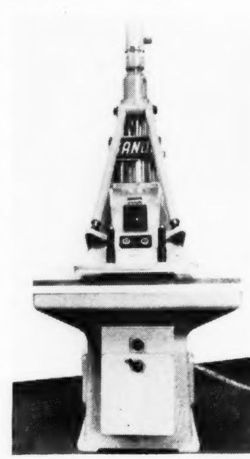
Bench-model bale cutter

A new bench-model hydraulic crude-rubber bale cutter has been introduced by G. F. Goodman & Son, Philadelphia, Pa.

Especially designed for use on the Banbury platform, in the laboratory, or in the compounding room to tail off batches, the bale cutter offers a bale clearance of 16 by 8 inches, delivers 2½ tons' pressure, and can complete three cycles in one minute.

Another one of the company's recent developments is a self-contained floor-model bale cutter, a hydraulic 2-hp. unit which includes motor, pump, and oil reservoir and delivers seven tons' pressure.

Hydraulic Clicker Press



New large clicker press

The new model ST 141 hydraulic clicking machine has been introduced by Atlas-Sandt Corp., New York, N.Y.

The machine's cutting table is 40 inches wide and 27 inches deep, with a cutting arm of 28 inches wide, which, in special construction, can be extended up to 36 inches. The cutting stroke is fully adjustable from 0 to 2¾ inches and can be set instantly by turning a knob on the cutting arm.

The manufacturer states that there is no handwheel on model ST 141 for the adjustment of the cutting arm such as is found on other types of mechanical or clicking machines. A simple touch of a push-button on the front of the cutting arm raises or lowers the arm setting, eliminating the need of the operator walking to the side or rear of the machine for setting.

(Continued on page 64)

TIRE FABRIC PROCESSING EQUIPMENT

AIR HEATERS

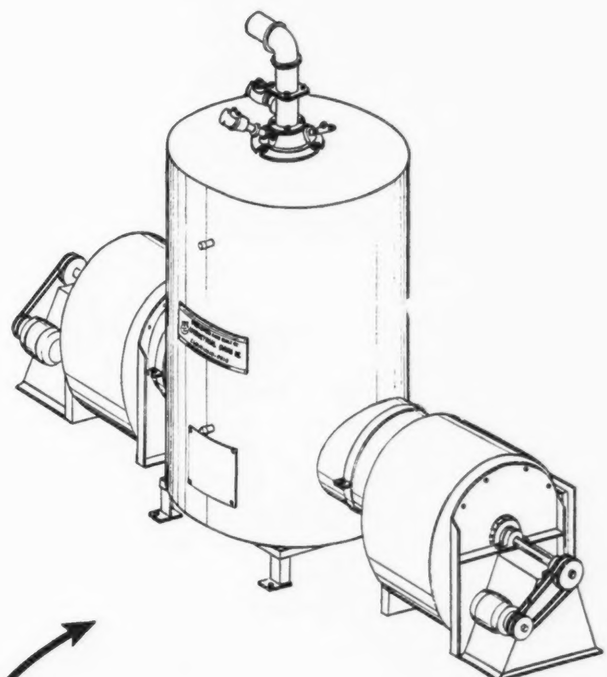
CYLINDRICAL, STEEL ENCLOSED
SPACE-SAVER TYPE UNIT
BALANCED DESIGN

FLAME INTERNALLY SEPARATED
FROM OUTER SHELL

SINGLE OR DOUBLE FAN
PULL OR PUSH-THRU TYPE HEATERS

COMPLETELY ASSEMBLED AND
INSULATED-READY FOR INSTALLATION

CAPACITY FROM 500,000 TO
10,000,000 B.T.U. PER HOUR
DIRECT GAS FIRED



MANY HUNDREDS OF SIMILAR UNITS ARE
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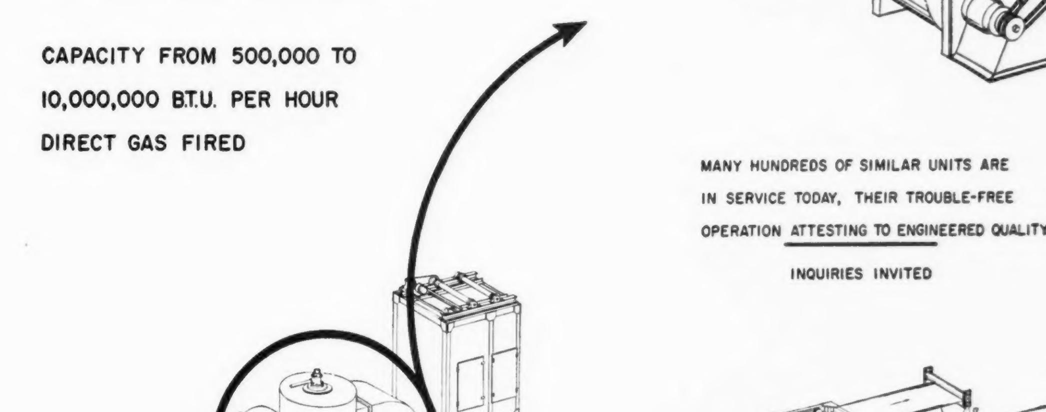
INQUIRIES INVITED

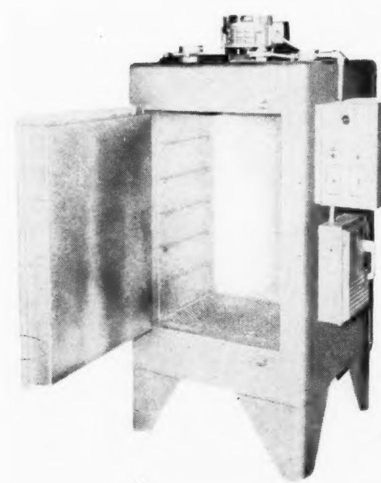


INDUSTRIAL OVENS, INC.
13813 TRISKETT ROAD CLEVELAND 11, OHIO

new equipment

(Continued from page 60)

The machine is recommended for use in the rubber industry, especially when heavy pressure for large-area die cutting is required. The hydraulic operation is said to give a perfect and clean cutting for gaskets of any size with single-or multiple-cavity cutting dies. Foam can be cut 2½ inches thick with steel rule dies of only one-inch height.



WOF Forced Convection Oven

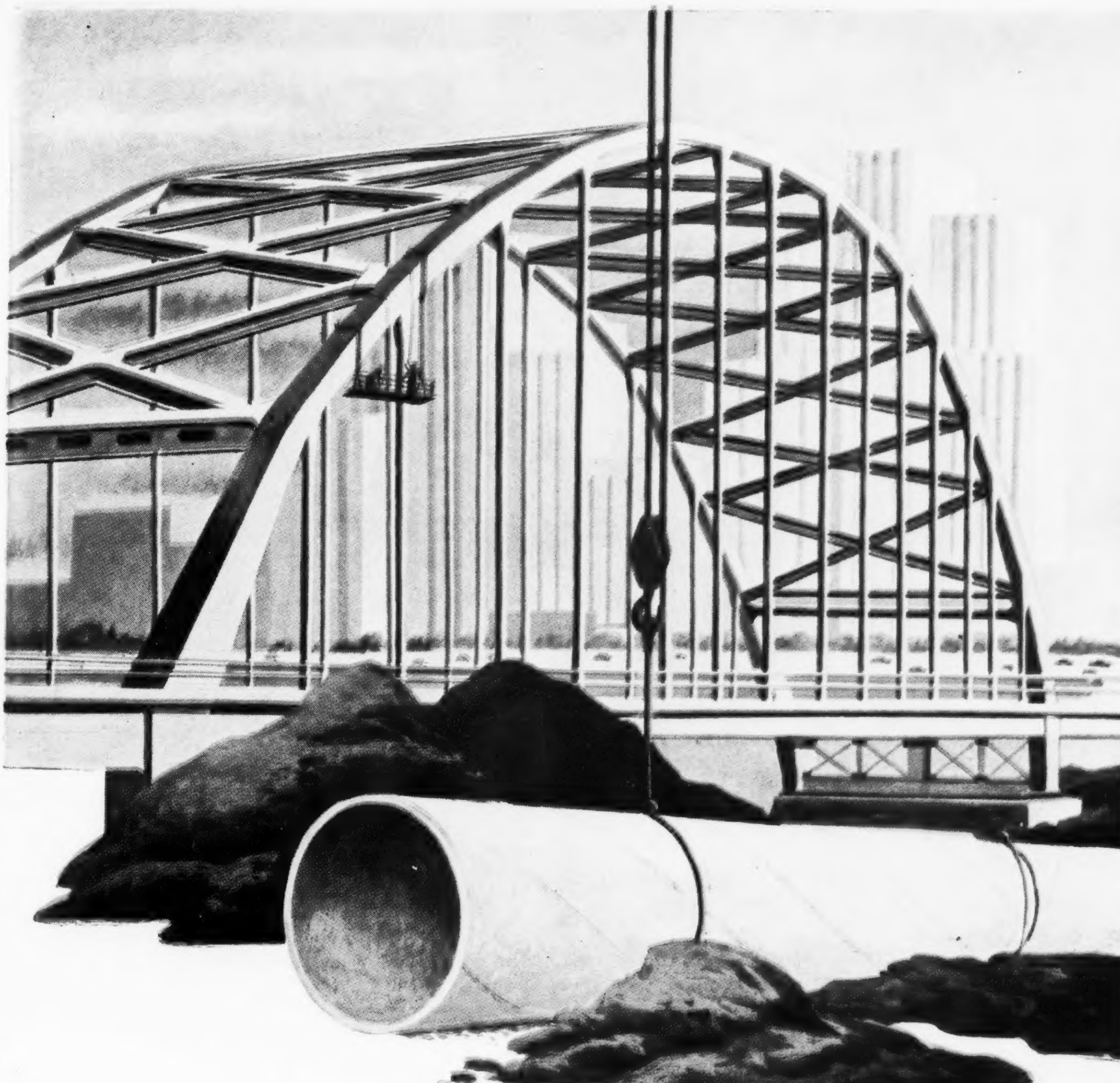
New All-Purpose Ovens

Two new improved model lines in its Forced Convection series of ovens have been introduced by Trent, Inc., Philadelphia, Pa., to provide closely controlled heat for processes with operating ranges to 1200° F.

The new WOF oven line ranges from 6 to 45 kw., from 24 by 36 by 18 inches to 60 by 72 by 60 inches inside, and operates on 240/480 volts, except in the smallest ovens, which are 240-volt only. Temperature range is to 650° F. (short runs to 750° F.), suitable for such uses as epoxy resin encapsulation and motor bakeout.

The HTOF ovens, for operating ranges to 1200° F., are available in models from 9 to 60 kw, 240/480 volts, and in the same range of inside dimensions as the WOF line. The former are suitable for such uses as glass annealing and firing and aluminum braze preheating.

"Sealless, Leakproof Chempumps." Bulletin 1053-1. Fostoria Corp., Chempump Division, Huntingdon Valley, Pa. 2 pages.



HUBER

CLAYS for the Rubber Industry—

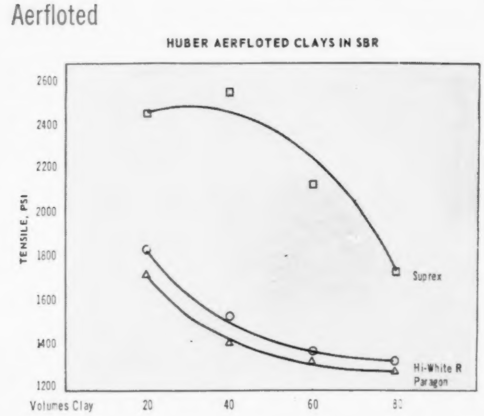
The most complete line of Aerfloted, Water Fractionated and Calcined Clays available!

High quality kaolin clays constitute one of the least expensive and most widely used rubber compounding ingredients. Uniformity, availability and excellent shipping service have made HUBER the leader in the rubber clay field. Whatever products you manufacture, a HUBER clay will fill an important place in your compounds.

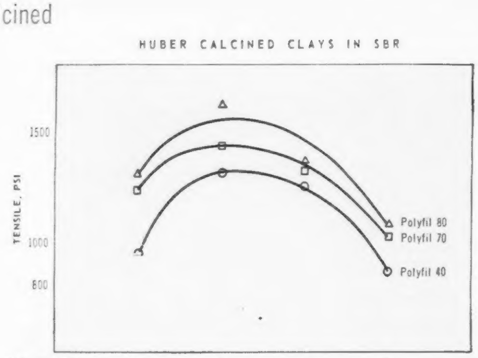
Formulation:

SBR 1502	100
Zinc Oxide	5
Cumar MH2½	7.5
Santocure	2
Sulfur	3
Clay	52—104—156—208
Volumes	20— 40— 60— 80

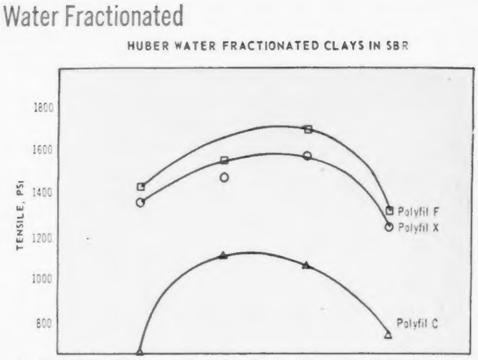
Aerfloted



Calcined



Water Fractionated



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editorial

Who Will Specify Tire Quality, Industry — or Government?

What is the rubber industry's responsibility to the public with regard to clear descriptions or grades and education to insure that a tire purchaser can select a "safe" tire for his particular service requirements?

During testimony on the proposed taxes on tires, tubes, and tread rubber at hearings of the House Ways and Means Committee, a witness presented the members of this Congressional group with cross-section samples of tires selling for less than $10 which were purchased from a Washington "department store" and a local "chain store" outlet. While it was not the primary purpose of the exhibit, these tires were described as "unsafe" by the witness who also suggested that some form of regulation (federal or state if not by the industry) is needed to protect the public from widespread use of these tires on the ever-increasing network of high-speed highways.

In Michigan, the purchaser of a set of tubeless tires with safety diaphragms won his suit against the manufacturer with his testimony that reliance on the claims of the advertising brochure had led to his injury by accident. He had had two of the tires apparently pull away from the rim on a sharp curve and go flat. The car rolled over, and he was injured. While the original ruling was set aside by a lower court, the Appellate Court reinstated the judgment and in its opinion said that the plaintiff was justified in his reliance of the statements and that a normally experienced and prudent person could not be expected to discover a lack of the qualities warranted by the manufacturer.

There is no question but that there are some very excellent tires on the market, but recent criticism of tire advertising, recession-born interest in lowest possible prices, and the extreme service conditions imposed by modern driving have created a suspicious attitude on the part of the public, the Congress, and safety authorities.

Reputable tire manufacturers must take steps to establish concise grades, promote safety, and treadwear economy of the better grades, and educate the public on tire limitations.

R. S. Walker

EDITOR

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RUBBER WORLD

Effect of Gel and Structure on the Properties of *Cis*-1,4 Polyisoprene[1]

Synthetic *cis*-1,4 polyisoprene made so as to have high molecular weight, relatively loose gel, and not over 5% 3,4 structure equals *Hevea* rubber in both raw and vulcanizate properties

By C. F. GIBBS, S. E. HORNE, JR., J. H. MACEY, and H. TUCKER

B. F. Goodrich Co. Research Center, Brecksville, O.

THE position of *cis*-1,4 polyisoprene (natural rubber) is well established in the world economy. It is also well known that although *Hevea* approaches 100% *cis*-1,4 structure, it varies as to molecular weight, gel content, cure rate, and plasticity.

The polymerization of isoprene to give polymers with such a high degree of stereoregularity that they approach *Hevea* in this respect has been reported in the literature (1).[2] These articles and patents concerned themselves with polymerization recipes, mechanisms, polymer structure, and vulcanizate properties. Probably the closest approach to the stereoregularity of *Hevea* in a synthetic polymer is that given by certain Ziegler catalysts. The polymer from a lithium catalyzed polymerization departs somewhat more from the *Hevea* structure.

In *Hevea,* the deviations in molecular weight, molecular weight distribution, plasticity-molecular weight relationships, and sol-gel relationships are such that it is not surprising that exact reproducibility by synthesis has not been achieved. The deviations, however, of the synthetic from *Hevea* are not great and, while measurable in the raw polymer state, have little or no detrimental effect on the vulcanizate. It is anticipated that in commercial manufacture the variation from lot to lot will be far less than now encountered in commercial shipments of natural rubber. In fact, it will be possible to establish specifications for synthetic *cis*-1,4 polyisoprene (*cis*-IR) which are as narrow as those now established for other synthetic rubbers.

In this paper we will consider how the polymerization of isoprene to a high *cis*-1,4 structure is influenced by the various factors. We will further consider how the properties of the resultant polymer are influenced by plasticity, the sol-gel relationships, and departure from stereoregularity.

Polymerization

A Ziegler catalyst, the reaction product of $TiCl_4$ with a trialkyl aluminum, polymerizes isoprene readily to a polymer consisting of about 96% 1,4 isoprene units, and insofar as has been determined, the double bonds are predominately in the *cis* configuration. The precise mechanism is largely a matter of conjecture because the identity and exact role of the catalyst have not been elucidated.

Following is a typical polymerization recipe:

Heptane	895 parts (by weight)
Isoprene	100
$(i\text{-}C_4H_9)_3Al$	2.11
$TiCl_4$	2.04
Ti/Al mole ratio	1/1

Laboratory-scale polymerizations are conveniently carried out in beverage bottles (2); these are conditioned by baking at 140° C. (284° F.) and cooling to room temperature under the flushing action of a vigorous stream of dry, oxygen-free nitrogen. All charging operations are carried out in an oxygen-free, dry nitrogen atmosphere. Generally the solvent is charged first, either by weight or volume; then the isoprene, trialkyl

[1] Somewhat revised version of a paper presented before Gesellschaft Deutsche Chemiker Fachgruppe, Kunstoffe and Kautschuk, Bad Nauheim, Germany, May 2, 1960. Original published in *Kautschuk und Gummi,* p. 336WT, Oct., 1960. A contribution from Goodrich-Gulf Chemicals, Inc., Cleveland, O., and the B. F. Goodrich Co. Research Center.

[2] Numbers in parentheses refer to bibliography at end of article.

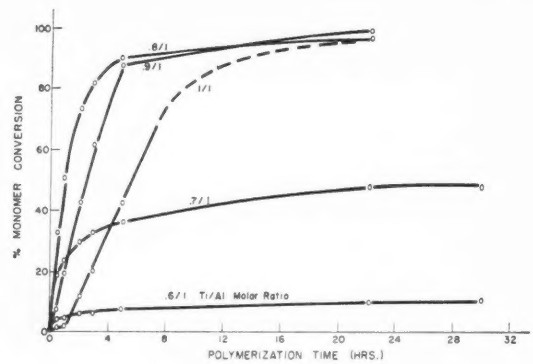


Fig. 1. Effect of Ti/Al ratio at a constant Ti concentration (7.9 m.moles/liter of charge) of $TiCl_4$ + $(i\text{-}C_4H_9)_3Al$ catalyst on the polymerization rate of isoprene in heptane

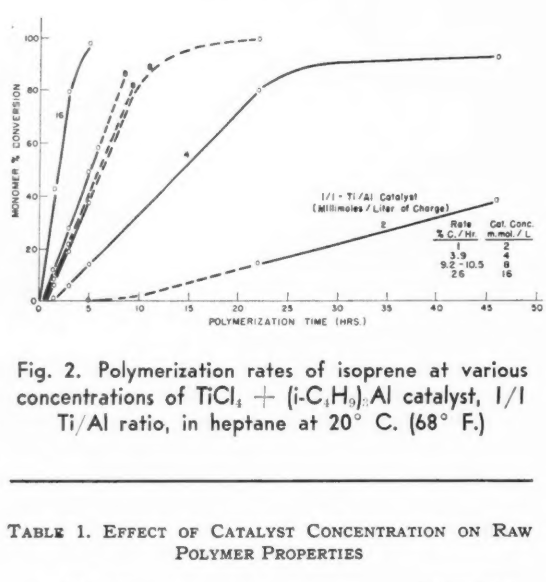


Fig. 2. Polymerization rates of isoprene at various concentrations of $TiCl_4$ + $(i\text{-}C_4H_9)_3Al$ catalyst, 1/1 Ti/Al ratio, in heptane at 20° C. (68° F.)

TABLE 1. EFFECT OF CATALYST CONCENTRATION ON RAW POLYMER PROPERTIES

Catalyst Conc. M. Moles $(i\text{-}C_4H_9)_3Al$ per Liter Charge	DSV*	% Gel	SI†	Mooney Vis. ML-10, 212° F.
3.10	2.91	32	54	53
4.20	2.77	22	61	40
5.47	2.87	29	52	45
5.97	2.46	19	62	29
11.9	2.52	26	61	33

* Dilute solution viscosity.
† Swelling index is ratio of swollen to dry gel.

TABLE 2. EFFECT OF CONVERSION ON RAW POLYMER PROPERTIES

Conversion, %	% Gel	SI	DSV
36	28	50	3.65
52	30	48	3.76
79	27	52	3.93
100	25	50	3.47

aluminum, and titanium tetrachloride are added by hypodermic syringe, and the bottles capped with puncture-type, self-sealing crown caps. While the order of addition is not critical, mixing of R_3Al and $TiCl_4$ in the absence of solvent or monomer results in a violent reaction. The bottles are pressured with nitrogen to a slight positive pressure by means of a hypodermic needle inserted through the self-sealing cap, clamped in a constant temperature bath, and tumbled end over end. Initially the catalyst flocculates and tends to settle rapidly, but as the viscosity increases, it becomes evenly dispersed and remains in suspension.

The puncture-type, self-sealing caps allow samples to be withdrawn (as for following conversion) and materials to be injected such as catalyst, monomer, solvent, or shortstop. Upon completion of the polymerization, the catalyst is deactivated by the injection of methanol or acetone, and the polymer precipitated by pouring the reaction mixture into a large volume of alcohol containing a dissolved rubber antioxidant. It is necessary to wash the polymer thoroughly to remove catalyst fragments for if these remain, they may retard the cure. Additional antioxidant is added during the washing operation to prevent degradation during the drying and compounding stages.

Both monomer and solvent must be free of impurities which will react with and inhibit or destroy the catalyst. These include water, oxygen, active hydrogen compounds, organic oxygen compounds, organic sulfur compounds, and hydrocarbons which will complex with and deactivate the catalyst. Of the latter, the most commonly encountered are acetylenes, cyclopentadiene, and cyclopentene. Aliphatic halogen compounds react violently with the catalyst.

Catalyst composition, as represented by the mole ratio of $TiCl_4$ to R_3Al, is of fundamental importance. Both polymerization rate and yield of polymer may be affected by comparatively small changes in ratio. Oddly, the ratio giving the fastest initial rate is likely to result in a low yield as the reaction may die at an early conversion. Figure 1 shows the effect of catalyst composition at a constant Ti concentration of 7.9 m. moles/liter of charge on the polymerization rate and conversion. Although the usual poisons normally destroy the characteristic brown color of the catalyst system, the color of the polymerization mixture does not change at the die-off point.

While the rate of polymerization is directly related to catalyst concentration (Figure 2) at a given $TiCl_4$/R_3Al ratio, Table 1 demonstrates molecular weight as represented by dilute solution viscosity (DSV) and Mooney viscosity of the dry polymer, to be relatively insensitive to catalyst concentration; thus it is impossible to obtain the high molecular weight found for *Hevea* by the method of reducing the catalyst level.

Both the rate of polymerization and molecular weight are temperature dependent. Molecular weight is independent of conversion under a given set of conditions. These results suggest that molecular weight is governed by a transfer mechanism based on the solvent or polymer and not by the numbers or nature of the active catalyst species. Figure 3 and 4 and

Table 2 show the actual magnitude of these effects.

The raw polymer can be subjected to any of the well-known evaluation procedures common to elastomers, but the two most commonly used have been Mooney viscosity[3] and sol-gel[3] determination. Both of these methods are well described in the literature and are in widespread use. Mooney viscosity is a measure of bulk viscosity under a selected set of conditions. The sol-gel method gives more information in that it separates the gel fraction, determines the character (relative tightness) of the gel, and gives a measure of the molecular weight in terms of dilute solution viscosity. Dilute solution viscosity, η, is defined by the following equation:

$$\eta = \frac{2.3 \log. \eta_r}{C}$$

η_r is the viscosity of the polymer solution relative to that of the solvent.
C is the concentration of the polymer solution in g/100 ml.

Factors Affecting Gel Formation

In the polymerization of isoprene with Ziegler catalysts, gel formation may be encountered. In the presence of aliphatic solvents, the gel content of the polymer formed is usually between 20 and 35%. With aromatic solvents, the gel is low and possesses a loose structure. The gel content of the polymer is relatively independent of both catalyst concentration (Table 1) and conversion (Table 2) and does not increase with standing of the unshortstopped polymerization mixture in an inert atmosphere.

The degree of crosslinking in a typical gel of swelling index 50 involves about one crosslink for 5,000 isoprene units as estimated by the approximate form of the Flory equation with correction for the formation of crosslinks in a swollen network (4).

$$M_c = \frac{d_2 V_1 (V_2^{1/3} V_0^{2/3} - 0.5 V_2)}{(0.5 - \mu) V_2^2}$$

d_2 = Polymer density
V_1 = Molal volume of solvent
V_0 = Volume fraction of polymer at time of crosslinking
V_2 = Volume fraction of rubber in the swollen network when swollen to equilibrium in the sol-gel determination
μ = Huggins interaction constant
M_c = Molecular weight between crosslinks

The mechanism of gel formation is a matter of speculation. The fact that gel is formed at about the same rate throughout the course of the polymerization indicates that it results from a secondary crosslinking reaction concurrent with propagation. The presence of regularly occurring, dangling isopropenyl groups, in the polymer chain, at a frequency of about one per 25 isoprene units offers a plausible mechanism for crosslinking, perhaps through cationic intermolecular polymerization. This action must occur as a matter of opportunity while the group is absorbed or complexed by the catalyst at the time of the propagation step. Only about 1% of the isopropenyl groups needs to be involved to explain the gel formation. The lower gel content of polymers made in aromatic

[3] ASTM, D 1646-59T. American Society for Testing Materials, Philadelphia, Pa.

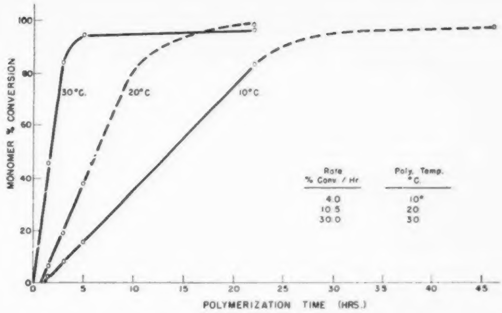


Fig. 3. Polymerization rates of isoprene at various temperatures in heptane

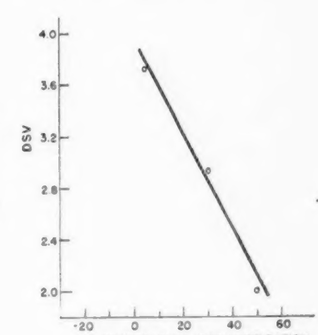


Fig. 4. Effect of temperature of polymerization on the molecular weight of polyisoprene

solvents must be related to the tendency of these solvents to complex with and to stabilize the element responsible for this secondary reaction. The stabilization of cationic species by aromatic solvents is well known.

Insofar as has been determined, the microstructure of gel does not differ from that of the soluble fraction other than the presence of crosslinks. Infrared reveals no measurable difference in 3,4 content or in the amount of *trans* structure. Furthermore, infrared does not show any differences in the structures of polymers prepared in either aliphatic or aromatic solvents even though the gel content varies widely in these two solvent systems. The possibility of cyclization or intramolecular polymerization, which is known to take place under the influence of Lewis acids, cannot be discounted although it has not been verified.

The Effect of Gel on Raw Polymer Properties

The problem of gel in synthetic rubbers prepared by free radical initiation in emulsion systems is well known (5). Here, too, the phenomenon of gel formation is brought about by secondary reactions which result in crosslinking. Generally, in the styrene-butadiene copolymer system this is to be avoided as much as possible although processing benefits are derived in some cases by the presence of crosslinked polymer (6). Also, the presence of gel has been studied in *Hevea*, and, recently, induced crosslinking has been employed to achieve advantages in processing (7).

In rather sharp contrast to the styrene-butadiene emulsion copolymers which crosslink rather easily under the influence of oxygen (8), *cis*-1,4 polyisoprene

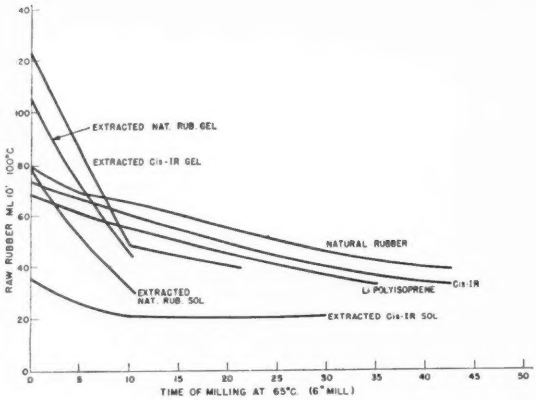


Fig. 5. Breakdown during milling of synthetic *cis*-IR *versus* natural rubber and extracted sol and gel portions therefrom

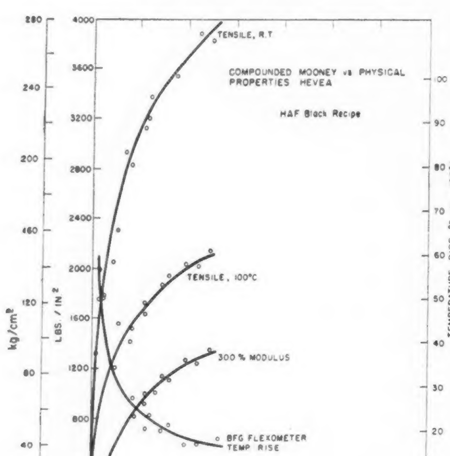


Fig. 6. Mooney viscosity of compounded stock *versus* physical properties of HAF black reinforced *Hevea* vulcanizates

molecules tend to cleave under oxidative conditions. Thus under the shearing stresses imposed by normal processing conditions, the gel fraction breaks down to a soluble condition unless the crosslinks are too close together. This condition can be estimated roughly from the swelling index (the ratio of the weight of the swollen gel to the weight of the dry gel). With swelling indices of 20 and over, generally the gel breaks down during processing to give a soluble rubber. If the swelling index is low, indicating tight gel with frequent crosslinks, the gel particle will not be cleaved during mixing, but will remain intact and behave much like a particle of filler.

Generally speaking, the Mooney viscosity of both *Hevea* and synthetic *cis*-1,4 polyisoprene is dependent upon both gel content and molecular weight Polyisoprenes made with lithium or butyl lithium are gel free and frequently of very high molecular weight, but have moderately low Mooney viscosities. *Cis*-1,4 polyisoprenes made in heptane with the Ziegler catalyst and containing 35% gel have substantially higher Mooney viscosities, but lower molecular weights of the soluble fraction. When the gel fraction is separated, it can be seen to have an extraordinarily high Mooney viscosity as does the gel fraction of *Hevea* rubber.

The shearing action of the rubber mill in the presence of oxygen or other radical reagents reduces the elastic character of a raw gum to a plastic condition by the process of mechanical chain scission and effectively reduces the molecular weight. Polymers of low molecular weights undergo less total cleavage than the higher polymers so that upon continued milling, both natural rubber and the synthetic *cis*-1,4 polyisoprenes tend to approach a common Mooney value.

The effect of this breakdown on a variety of *cis*-1,4 polyisoprene is shown in Figure 5. The gel fractions of both natural rubber and synthetic *cis*-1,4 polyisoprene have high initial Mooney viscosities, but break down rapidly upon milling to something less than 50-ML 10 min. (100° C.), at which point the rate of breakdown diminishes sharply. The sol fraction of natural rubber, which itself has a fairly high Mooney viscosity, breaks down as rapidly as does the gel fraction. The soluble fraction of the synthetic *cis*-1,4 polyisoprene of Figure 5, which is low in Mooney viscosity at the start, breaks down only slightly and reaches a condition where apparently no more cleavage occurs under the particular milling conditions.

Effect of Gel on Vulcanizate Properties

A small amount of gel reduces flow and increases the bulk viscosity of the raw rubber, and so it can be an asset with respect to mixing. Blacks, other fillers, sulfur, and accelerators are better dispersed because of the increased internal shear. This results in better stress-strain properties, lower Goodrich flexometer temperature rise,[4] etc. If the polymer is low in viscosity, too little internal work is imposed upon the black batch during the mixing process, and poorer dispersion results. This leads to poor reinforcement, which is reflected by low-quality physical properties. If tight gel is present, it apparently is not broken down during the milling process; sulfur and accelerator probably are not dissolved within the gel particles to the same degree that they are in the sol fraction so that uniform vulcanization does not take place.

In studying the effect of structural features of the *cis*-1,4 polyisoprenes on vulcanizate properties, we have chosen to use the Mooney viscosity of the mixed stocks (compounded Mooney) as the basis for making comparisons. This measurement provides a better standard than would dilute solution viscosity or sol-gel relationships as it includes mill breakdown effects and establishes comparative relationships just prior to the vulcanization process. Vulcanizate properties are plotted against compounded Mooney, ML 10 min.

[4] ASTM D 623-58T, American Society for Testing Materials.

(100° C.). The physical properties of cured natural rubber and synthetic *cis*-1,4 polyisoprenes were determined on vulcanizates prepared from the following recipes:

VULCANIZATION RECIPES

	Hevea		Synthetic *cis*-Polyisoprene	
	Black	Gum	Black	Gum
Rubber	100.0	100.0	100.0	100.0
Stearic acid	3.0	3.0	3.0	3.0
DPPD (a)	0.3	0.3	f	f
AgeRite White (b)	0.7	0.7	f	f
Zinc oxide	5.0	5.0	5.0	5.0
MBTS (c)	1.0	1.0	1.0	1.0
Sulfur	2.0	2.0	2.0	2.0
HAF black	45.0	—	45.0	—
Lecithin—TEA (d)	—	—	1.5	1.5
Oil (e)	5.0	—	5.0	—

(a) N, N'diphenyl-p-phenylene diamine
(b) N, N' di-β naphthyl-p-phenylene diamine
(c) Benzothiazyl disulfide
(d) 95% Soya lecithin, 5% triethanolamine
(e) Highly aromatic petroleum oil
(f) Added to raw polymer at time of manufacture

Figure 6 gives the effect of compounded Mooney viscosity on various vulcanizate properties of *Hevea* in a HAF black reinforced compound. Optimum cure values; based upon point of inflection of modulus *versus* time of vulcanization curve, have been chosen in every case. It is significant that all values, except Goodrich flexometer temperature rise, tend to increase to a more or less constant value as Mooney viscosity increases. The flexometer temperature rise, which depends upon optimum crosslink pattern, requires a selected high molecular weight for optimum values, decreasing as the compounded Mooney viscosity increases.

Figures 7 and 8 present plots for a high molecular weight, Ziegler catalyzed *cis*-1,4 polyisoprene with comparatively low gel and high swelling index and a similarly prepared polymer with moderate gel content which has a lower swelling index. Here, the differences in vulcanizate physical properties are small at like Mooney viscosity values of the compounded stocks, with slight, if any, advantage to the polymer with the greater swelling index of the gel.

Similar values comparing a typical Ziegler catalyzed *cis*-1,4 polyisoprene (35% gel) with one containing 45% gel and a swelling index of 8 are found in Table 3. Here it is seen that vulcanizate properties have definitely suffered as the result of high, tight gel. Such polymer would be unsuitable for most uses.

A typical Ziegler catalyzed *cis*-1,4 polyisoprene was separated into sol and gel fractions which were then compounded and tested separately. Table 4 gives the results in a gum recipe; while the corresponding values for black-loaded stocks are found in Table 5. The

TABLE 3. COMPARISON OF BLACK REINFORCED VULCANIZATE PROPERTIES FROM MODERATE AND TIGHT GEL SYNTHETIC POLYISOPRENES

Gel, %	35	45
Swelling index	40	8
Tensile strength, R.T., kg./cm.² (psi.)	310 (4410)	162 (2310)
Modulus, 300%, kg./cm.² ((psi.)	99 (1400)	—
Elongation, %	630	280
Tensile strength, 100° C., kg./cm.² (psi.)	176 (2500)	102 (1450)
Hardness, Shore A	64	74
Goodrich flexometer, ΔT, °C. (°F.)	21 (69.8)	31 (87.8)

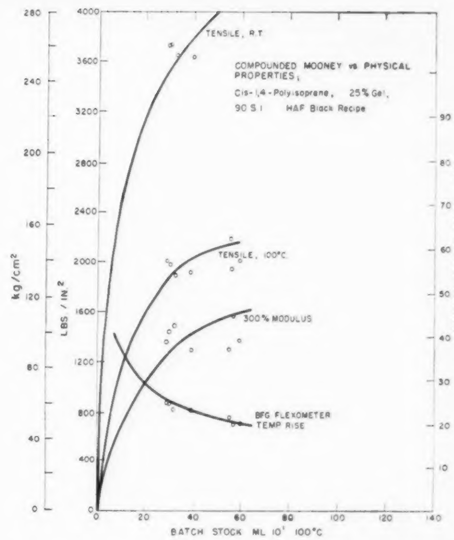


Fig. 7. Mooney viscosity of compounded stock *versus* vulcanizate physical properties of HAF black reinforced synthetic *cis*-1,4 polyisoprene of 25% gel and 90 swelling index

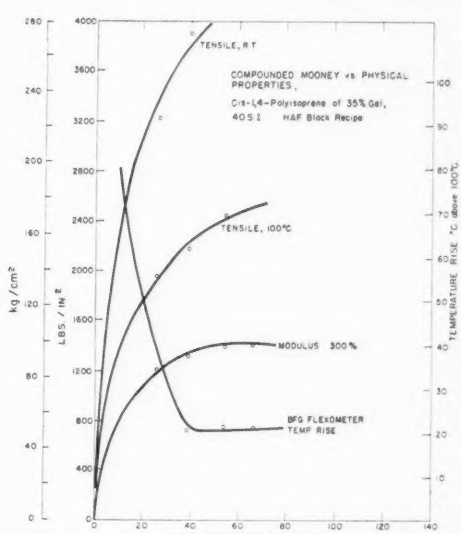


Fig. 8. Mooney viscosity of compounded stock *versus* vulcanizate physical properties of HAF black reinforced synthetic *cis*-1,4 polyisoprene of 35% gel and 40 swelling index

TABLE 4. PURE GUM VULCANIZATE PROPERTIES OF SOL AND GEL FRACTIONS OF SYNTHETIC *Cis*-1,4 POLYISOPRENE

	Sol	Gel
Tensile strength, R. T., kg./cm.^{2} (psi.)	190 (2700)	172 (2450)
Modulus, 300%, kg./cm.^{2} (psi.)	7 (99)	42 (597)
Elongation, %	810	460
Hardness, Shore A	27	40
Goodrich flexometer, ΔT, °C. (°F.)	3 (5.4)	2 (3.6)

TABLE 5. BLACK REINFORCED VULCANIZATE PROPERTIES OF SOL AND GEL FRACTIONS OF SYNTHETIC *Cis*-1,4 POLYISOPRENE

	Sol	Gel
Tensile strength, R. T., kg./cm.^{2} (psi.)	191 (2720)	212 (3020)
Modulus, 300%, kg./cm.^{2} (psi.)	63.2 (900)	148 (2100)
Elongation, %	610	400
Hardness, Shore A	46	68
Tensile strength, 100° C., kg./cm.^{2} (psi.)	118 (1680)	85 (1210)
Goodrich flexometer, ΔT, °C. (°F.)	25 (77)	25 (77)

stocks from the sol fraction show the effect of lower primary molecular weight, particularly in the 300% modulus values. The tensiles, while low, are not below acceptable standards. The gel fraction evidently broke down during milling to give a stock that is essentially normal. While the tensile and elongation values are somewhat lower than those usually encountered for black-loaded *Hevea* rubber, the balance of properties is good and would be generally acceptable for tire treads.

From the foregoing examples it can be concluded that loose gel, high swelling index, being typical of Ziegler catalyzed *cis*-1,4 polyisoprene rubber, breaks down during processing to a soluble form which in the compounded state behaves much like natural rubber. By adding toughness to the raw polymer, such gel is actually beneficial in that it aids in black dispersion, which, in turn, results in better physical properties than those obtainable from lower molecular weight, gel-free polymers.

Effect of Increased 3,4 Content

With the exception of solubility and viscosity, considerable crosslinking in *cis*-1,4 polyisoprene has little effect on the basic physical properties of the raw polymer and almost none on vulcanizate properties. Deviations in the microstructure of the polymer chain, however, result in pronounced effects on both raw polymer and vulcanizate properties. The deviations discussed here are those from the 1,4 structure produced by the 3,4 polymerization of some of the isoprene molecules. Similar effects could be anticipated by an increase in *trans* content, but these have not been studied in any detail.

Although there is currently a controversy regarding the use of the infrared absorption peak at 11.25 μ for estimating the amount of 3,4 structure in polyisoprenes (9), we have chosen to use this method. The values admittedly are approximations.

TABLE 6. EFFECT OF 3,4-POLYMER STRUCTURE ON CIS-POLYISOPRENE PROPERTIES (GUM RECIPE USED FOR VULCANIZATE PROPERTIES)

3,4 Content, %	3	5	10	30
DSV	3.27	3.20	6.98	7.86
Gel, %	0	37	0	32
Swelling index	—	28	—	204
Second-order transition, °C.	—75	—75	—68	—51
Modulus, 600%, kg./cm.^{2} (psi.)	81.6 (1160)	93.5 (1230)	44 (625)	9.8 (140)
Tensile strength, R. T., kg./cm.^{2} (psi.)	248 (3530)	182 (2590)	97.5 (1385)	28.8 (410)
Elongation, %	730	690	700	850
Tensile strength, 100° C., kg./cm.^{2} (psi.)	68.2 (970)	38.7 (550)	16.2 (230)	2.8 (40)
Elongation, %, 100° C.	560	480	400	300
Goodrich flexometer, ΔT, °C. (°F.)	4 (7.2)	4 (7.2)	5 (9)	8 (14.6)

While *Hevea* is believed to contain some 3% of 3,4 polyisoprene structure, Ziegler catalyzed *cis* polyisoprene contains perhaps twice this much and lithium polyisoprene about 10%. A modified Ziegler catalyst has been found which gives roughly 30% 3,4 structure. When the initiator is sodium, the 3,4 content of the resulting polymer is about 60%, with substantial amounts of *trans* being also present.

One of the most obvious (and least understood) properties affected by increased 3,4 content is tack. Like *Hevea*, *cis*-1,4 polyisoprene made by the Ziegler catalyst exhibits excellent tack. When the 3,4 content of the polymer increases to 10%, as in the case of lithium catalyzed polyisoprene, tack is almost completely absent; nor is it found in polyisoprenes of greater 3,4 content. While the basis for tack is not understood, there appears to be good evidence, in the case of polyisoprenes at least, that a high degree of molecular order is required.

Table 6 shows the effects of 3,4 structure on some of the properties of *cis*-1,4 polyisoprene. The second-order transition temperature, as measured by the thermal expansion method (10), is raised by an increase in the 3,4 content of the polyisoprene. The magnitude of this increase is small up to 3,4 contents of about 10%, but the second-order transition temperature increases rapidly in the range of 10-30% 3,4 structure. There is no reason to believe that it would not continue to increase at higher 3,4 levels.

Compounding of the polyisoprenes in the pure gum recipe shows a marked influence of 3,4 structure on the vulcanizate properties. The tensile and 600% modulus drop rapidly as the 3,4 content increases; the elongation is affected but little. Tensile measured at 100° C. shows a steady drop with increasing 3,4 content and almost complete loss of tensile strength at the 30% level. A detrimental effect is also noted in the hot elongations. Goodrich flexometer temperature rise

(*Continued on page 82*)

Self-Bonding Silicone Rubber

By R. P. DeSIENO
General Electric Co., Waterford, N. Y.

THE introduction of a bonding grade of silicone rubber—a compound that will bond ferrous metals with an adhesive force stronger than the material itself, promises to be a boon to mechanical rubber fabricators who make such items as oil seals, shock mounts, rubber-covered rolls, or other specialty products.

Bonding operations have often been time-consuming and involve a number of steps. One step is the use of a primer, which had to be cured before the silicone rubber could be applied. This new self-bonding rubber eliminates the primer and essentially cuts the process from a seven-step method to three steps, a solvent wash, applying the compound, and curing the compound.

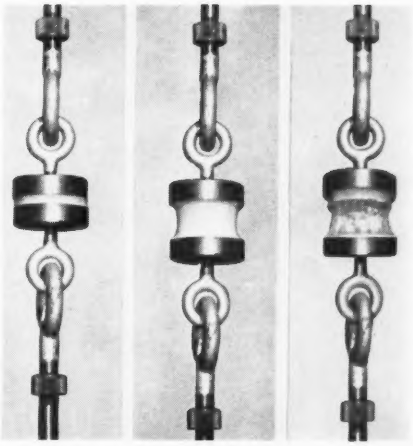
The new self-bonding grade achieves a direct bond as a result of chemical interaction between the bonding stock and the material to be bonded rather than depending upon the primer to establish the active force in establishing the bond. The strength of this new bond considerably exceeds the strength of the stock being used. Thus tests produce a cohesive failure (rubber structure failure) rather than adhesive failure (bond failure). Lab tests which have applied direct pulling stress on rubber/metal bonds have failed to destroy the bond at stresses exceeding 1500 psi. Use of a primer actually hinders the bonding of the self-bonding silicone rubber. Excellent bonds have been established to steel, chrome steel, and stainless steel. Aluminum and aluminum alloys do not give bonds of a quality comparable to those of iron-containing alloys.

Bonding of the new material to silicone rubber also produces excellent results. The high-strength bonds are best established when the rubber to be bonded contains small quantities of transition metal oxides (iron, nickel, chromium, or titanium oxide). As in the case of rubber-to-metal, rubber-to-rubber bonds are established by a direct chemical reaction between the self-bonding rubber and the conventional silicone rubber to be bonded.

Processing of the self-bonding rubber is excellent. The compound bands quickly on the mill and builds little structure on extended shelf aging. Green strength is comparable to that of General Electric Silicone SE-555. Catalyst acceptance and dispersion are said to be excellent, with a minimum of mixing required.

Bonding Technique

Beyond reasonable cleanliness, no extraordinary surface preparation methods are required. The surface should be mechanically cleaned of any visible oxidation. A solvent wash of toluene or xylene, followed by an acetone rinse will suffice to remove grease or surface contamination.



This series of pictures illustrates the failure of the rubber rather than the bond during test of the new self-bonding silicone rubber of General Electric Co.

Press-cure cycles should be extended over normal fabrication techniques, particularly where thick sections are being used. Pressure should be used to insure intimate contact and help force out air and volatiles which might degrade the rubber structure and bonding ability.

Cure time and temperature variations will depend upon the geometry of the system and the catalyst used to vulcanize the rubber. Dicumyl peroxide, varox, and benzoyl peroxide all perform satisfactorily with respect to promoting adequate vulcanization and permitting excellent bonding.

Typical Cure Cycle

Cure cycle time recommendations for general applications are as follows: Press cure the stock for 15 to 30 minutes at 270-300° F., using benzoyl peroxide and 15 to 30 minutes at 330-350° F., using varox or dicumyl peroxide. A post-bake of 16 hours at 350° F. is recommended for optimum rubber cure and bond strength. This cure cycle works particularly well for deep or thick section cures.

Catalyst level recommendations are essentially comparable for all catalysts. A catalyst concentration

(*Continued on page 82*)

Conveyors Roll into New Fields

Make gains in passenger transportation, food processing, mail and baggage handling

A special RUBBER WORLD report
By STUART V. d'ADOLF

USE of specialty rubbers, synthetic fiber carcasses, and new constructions has enabled conveyor belts to make inroads into specialized fields while continuing to increase use in heavy hauling—still the backbone of the conveyor industry.

Just recently, for example, New York City's busy Grand Central Terminal completed installation of a conveyor system to move mail rapidly in both directions between trucks at street-level loading platforms and trains several levels below.

The system, first of its kind at a rail terminal, will handle more than 15,000 pieces of mail a day for the two railroads which share the terminal, the New York Central and the New York, New Haven & Hartford. Originally begun because construction of Grand Central City is taking part of the terminal's loading docks, the move will save the railroads nearly half a million dollars a year in handling costs and will return the cost of the installation in less than a year, the railroads estimate.

The terminal is also installing two other conveyors, one to speed handling of 650 to 700 pieces of baggage a day, other than hand luggage, and the other to load newspapers on to out-of-town trains. Anyone who has ever hefted a Sunday *Times* realizes that the last project is not necessarily the least.

Grand Central's installation is just one of many conveyor systems designed to speed mail, baggage, and package handling. At Idlewild International Airport in New York and at San Francisco International Airport, conveyor belts whisk baggage to and from United Airlines jets at 300 feet a minute, or faster than passengers can walk to and from planes. In Portland, Me., an automated post office is the first of many which will use conveyors to speed letters and packages between processing points, but other older post offices are being updated by addition of conveyor equipment.

Conveyors have also found many uses in plant assembly and inspection lines, food sorting, carrying passengers, and processing foods with so-called "built-in maid service," such as ready-to-cook or serve pastries, meats, vegetables, and desserts.

Belting Sales Up 29%

The increase in sales in the past five years, although partly due to rise in prices, indicates the great increases in the use of conveyors between 1955 and 1960. Because of the heavy investments in specialized equipment required for manufacture of belting, there are only 12 companies in the belting field, The Rubber Manufacturers Association, Inc., reports. However, development of solid-woven carcass belting, which is simpler to manufacture than the present multi-ply belts, may encourage entry of new firms into the field.

At present the leaders are three of the rubber industry's Big Four, Goodyear, Goodrich, and U. S. Rubber; the Manhattan Rubber Division of Raybestos-Manhattan, Inc.; the Thermoid Division of H. K. Porter Co., and Hewitt-Robbins, Inc. Hewitt-Robins also manufactures conveyor components and complete conveyors.

Although continued developments in conveyors may shift emphasis to specialized uses of belting, the main use for conveyor belting is still heavy hauling. Many of the developments in the past few years, therefore, have been directed at making it possible for conveyors to compete with trucks, barges, and trains in such fields as coal, metals, and minerals mining; transportation of ore, mineral products, lumber and wood products, and construction materials; hauling bulk food products; and loading and unloading a variety of cargo.

Greater Capacity with Smaller Belts

Five years ago the main emphasis in heavy hauling was on size of belts, both length and width. Since size was the key to increasing capacity and cutting costs, competition has brought the 72-inch belt into frequent use for heavy hauling, and manufacturers seemed to be in competition to produce the longest single flight of belting. Since each flight requires its own drive motor and transfer mechanism, in most cases the fewer flights needed for a given job, the lower the operating cost.

Today there are still 72-inch and even wider belts in use, and only recently a Goodyear project included a 12,000-foot single flight of belting, one of the longest in the world. Nevertheless the emphasis has been shifted away from size by improvements in construction and materials which have enabled manufacturers to increase capacity by increasing belting speeds and using a steeper angle of troughing for their belts, while retaining "average" belt widths of 36 to 48 inches.

Doubling the speed of a belt effectively doubles its capacity, and speeds of belts are up from an average of 350 feet per minute and a high of 500 to 600

A green-colored rubber conveyor *(see facing page)* is used for grading corn in the Stayton Canning Co. food processing plant in Oregon in order to highlight color variations in the ears of corn, making the off-grade ears stand out

A mail sorter in Boston's South Station Post Office sends letters on their way to the cancelling machine. In the past five years most major post offices have speeded handling by installing conveyor systems

feet five years ago, to an average of 400 to 450 feet and a high of 700 to 900 feet today. In Germany some types of belts used for mining are running at speeds of 1,900 to 2,400 feet a minute. The heavier the material, the easier it is to increase speeds without spillage.

More important, perhaps, for the majority of jobs is the increase in angle of troughing. Five years ago the troughing angle for the average belt was 20 degrees. Today the tendency is to use belts which will trough at angles up to 45 degrees. The increase in troughing angle means an increase in effective capacity of anywhere from 25% at an angle of 33 degrees, to 33% at 45 degrees. It also decreases spillage of materials.

Improvements in Carcasses

With greater angles of troughing there were greater strain on the carcass fabric and considerably increased abrasion on the cover at the place where the bottom of the belt forms a sharp angle with the side.

Most belts are made with a "carcass" of several plies of fabric protected by "frictions," or rubber pressed into the fabric. The plies are insulated from one another, and at the same time bonded together, by "skims," or coatings of rubber calendered on to each ply. The carcass is protected by a cover of rubber, chosen for resistance to abrasion, heat, oils, or whatever aging factors it will encounter in service.

Carcasses are basically subject to three strains: the lateral strain caused by troughing, the longitudinal strain of the load, and the tendency to ply separation caused by centrifugal force. As any tire manufacturer knows, the higher the speed, the greater the tendency to ply separation.

Some of the major efforts over the years to improve belting have centered on construction of carcasses. To bear the strains of heavier loads, manufacturers used heavier and heavier fabrics, from 32-ounce cotton duck in 1920 to 48-ounce duck in 1939.

Eventually the limits of heavier cottons were reached. For one thing, there is a limit to the tensile strength of cotton duck—about 65 pounds per inch per ply. For another, the heavier the fabric, the stiffer it is, making it difficult to trough at high angles.

Synthetics Replace Cotton Duck

Synthetics are used singly or in combination, and in combination with cotton, all in the interest of greater tensile strength and more flexibility. The strongest belts are usually made of high-tensile rayon with nylon cross-strands, or "fill," and cotton and nylon belts are used for heavy-duty work where the ultimate in tensile strength is not required. A recent trend is for some manufacturers to replace nylon with rayon to produce a rayon and cotton belt. The fact that rayon is more bulky than nylon, usually considered a drawback, is felt by them to be an advantage because the added bulkiness helps to cushion the impact of materials falling on to the belt and thus cuts down on abrasion.

There has also been some use of other fibers in combination, such as Dacron for heat resistance and asbestos as a fire break, and U. S. Rubber has developed and patented a method of bonding the warp and woof strands to give greater fabric strength.

Belting with the newer fabrics develop draw bar tensile strength of 200 pounds an inch or better per ply, and Hewitt-Robins recently introduced Ray-Nile and Super Ray-Nile belting, which work up to tensions of 300 pounds an inch per ply, or better, equivalent to the strength of steel. It is estimated that a five-ply belt of rayon and nylon could move a load of 400 tons an hour 30,000 feet horizontally in a single flight, and 3,000 feet on an incline. This compares with 7,000 feet horizontally and 750 feet on an incline for a cotton duck belt.

The problem of greater troughing has been met not only by use of synthetics, but in some cases by use of some form of cord construction. Raybestos-Manhattan, for example, uses a "Homocord" construction of lengthwise members made of four lengthwise strands twisted together, connected by a few crosswise strands. This leaves more room for skim to be pressed into the fabric.

B. F. Goodrich uses a "Nycord" construction, with each lengthwise cord embedded separately in rubber. In addition to easier troughing, both belts have the advantage of better insulation so that water or acid entering through a cut in one part of the belt cannot harm the fabric in the rest of the belt.

The greater tendency to ply separation caused by greater speeds has brought on considerable research in improved bonding of plies, with chemical bonding supplementing physical bonding.

Another development, strictly experimental at this point, is use of "oriented" sheet nylon instead of woven fabric for carcasses. The sheet nylon is said to have very high tensile strength, but lower flexibility at present than woven fabric. Besides, it presents difficulties in splicing.

Solid Carcass Belts

The most interesting recent development is the solid-woven carcass, or single-ply belt. All-cotton solid carcass belts have been made for many years, but did not have the strength or toughness for general service. Use of snythetics has changed this picture. The increased tensile strength they afford have made it possible to construct solid-carcass belts with a tensile strength of 210 pounds per inch, the maximum for a four-ply, 48-ounce cotton duck belt.

The solid-carcass belt has the advantages of being lightweight and extremely flexible for the maximum in training and troughing on idlers. Since there is only one ply, it does not have the problem of ply separation at high speeds. It is claimed, moreover, to have very high resistance to cover separation, since the cover is pressed deep into the weave of the carcass.

The solid-woven carcass is woven on one loom as a unit, made of heavy-duty cotton cords which are interwoven in both the warp and filler directions. The result is one heavy ply with a coarse weave.

The carcass is impregnated with either rubber or poly (vinyl chloride), and a cover of the same material is then put on and pressure applied so that the underside of the cover is pressed into the carcass.

Baggage from United Airlines planes at Idlewild Airport in New York is loaded on to a conveyor which will bring it to the check-out area faster than passengers can walk from their planes to the terminal

Visitors to Freedomland in New York ride the Stephens-Adamson Co. conveyor using Goodyear belting. The conveyor is one of 50 passenger-carrying conveyors in the United States, most of which are considerably longer than this one

Standard rubber covers are available on solid-woven carcasses, with Hewitt-Robins selling a complete line, including solid-woven impregnated with PVC and with a PVC cover.

The big potential seller is the solid carcass with the PVC cover. Although the belts are used mainly for underground coal mining at present because they stiffen at low temperatures, they have good abrasion resistance and flame resistance. But they have poor cut and tear resistance and, more important, a low coefficient of friction, making necessary a cover design which will eliminate load and drive slippage.

However, such covers are cheaper than conventional covers and, in addition, do not need the huge curing presses and other equipment required for conventional belts.

Belting Covers Also Improved

Improving the carcass was only part of the job to be done. Manufacturers have also done considerable research on rubbers to be used in the belt cover, which may have to have high abrasion resistance, oil resistance, resistance to heat or cold, to fire, to weather aging, and to sticking.

More than half the covers in use today are made either of natural rubber or of SBR, with the latter taking over most of the market except where top physical properties are needed. CR (neoprene), which combines resistance to abrasion, oil, and heat with resistance to fire and weather aging, has been used by belting manufacturers for such tasks as carrying oil sprayed coal, and underground ore carrying where fire resistance is necessary. NBR (nitrile) rubbers are used where oil resistance is especially important, such as in food processing, carrying forest products, and grain hauling.

IIR (butyl), which has good heat and abrasion resistance and weather aging resistance, is used a good deal where oil resistance is not needed, particularly at high temperatures. Other entries include the polyurethanes, which combine high tensile strength with reportedly higher resistance to abrasion than either steel armor plate or ceramics; poly(vinyl chloride), which is cheap and has good abrasion resistance; and the silicone rubbers, used both because of their low-temperature flexibility and because of their non-stick qualities.

Uses of Colored Belting

While not so basic, development of color belting has meant improvements in factory assembly and inspection. In one case, a manufacturer ordered a green belting for inspection of machine parts because the conventional white belting previously used for the purpose placed too much strain on the eyes of the inspector.

In other cases belting has been chosen to approximate or contrast with the color of the product so that off-color items would stand out. U. S. Rubber, which makes belting covers in a great variety of colors, gives an example of a tan belting provided for inspection of dry cereal which was the same color. Goodrich, on the other hand, has made a green belt for Stayton Canning Co., Stayton, Ore., so that off-color ears of corn stand out against the green.

In addition, since belting used for food handling must be non-toxic, all manufacturers do research on compounding ingredients to make sure they are harmless for consumption.

Other changes include such devices as a series of pie-shaped lengths of belting to make it possible for conveyors to turn at angles up to 90 degrees, and molded top surfaces with projections or cleats to carry packages or soupy materials on inclines. The belting at San Francisco International Airport uses both devices.

Another device is the turnover belt, used for ore carrying. A mile-long Hewitt-Robins belt is used for carrying iron ore at the Cleveland Cliffs Mining Co., and a Goodrich belt, at the Pittsburgh-Midway Mining Co., Drakesboro, Ky. The belt, turned 180 degrees at each end of the flight, is always positioned to receive the load, but only the clean side of the belt is allowed to run on top of the return idlers. This prevents clogging, or buildup of tacky materials on idlers, or pulleys, and cuts down abrasion and corrosion of the idlers.

In constructing Wendover Air Force Base outside Salt Lake City, Hewitt-Robins used a feeder belt to cut down abrasion on the main belt, which traveled at 900 feet a minute. Since materials falling on to a high-speed belt cause considerable abrasion, a feeder belt was made to travel at a speed slightly less than that of the main belt. Materials were fed on to the feeder belt, which dropped them on to the main belt. The effect was that of dumping them on to a belt moving at a very low speed. Abrasion of the feeder belt was high, but it was easy to replace.

Passenger-Carrying Conveyors

Although the moving expressways of science fiction are a long way from reality, the next decade will probably see an acceleration in the use of passenger-carrying belts over short distances. One of the earliest passenger-carrying belt was put in operation in Jersey City about six years ago at the Hudson & Manhattan Railroad's Erie Station. At about the same time a similar belt was put into service at Love Field in Dallas.

There are now about 50 such belts in the United States, the majority of which is apparently used to cover vertical distances, similar to an escalator. These include two in Chicago, one at Wrigley Field, and another in the rapid transit station at 63rd and Loomis Streets, and others at department stores and auditoriums in Houston, Tex., Las Vegas, N. M., Aberdeen, Wash., Atlanta, Ga., and Little Rock, Ark. In Tacoma, Wash., the city is building a series of belts to eliminate heart-taxing climbs on the city's steep hills. In Atlanta, city officials hope eventually to eliminate most of the auto traffic in its downtown area and replace it with an elevated, car-carrying conveyor belt which will whisk 20,000 passengers an hour through the downtown area.

Abroad, passenger-carrying belts have been used for some time. One of the most recent carries passengers 312 feet at 180 feet a minute from Waterloo Station in London to the Bank, terminus of a branch subway line.

New Tire Construction Joins Nylon and Rayon

Seiberling's new "Nytex" tire with both nylon and rayon cords is designed to provide safety and comfort, ease multiple inventories, and eliminate the question, "Which should I buy?"

A COMBINATION rayon/nylon cord tire has been developed and will be marketed in the United States and Canada by the Seiberling Rubber Co. In this "wedding" of the two cords, the company's engineers feel that they have been able to take advantage of the best features of both and minimize or eliminate most of the undesirable characteristics of either.

This is the first known instance of this type of construction being used in this country, at least in actual production. It has long been felt by most tire designers that such a construction would be unfeasible. There has been a report, however, that Pirelli has also developed a dual cord tire in Italy and has furnished it to Fiat cars. But no details on the Pirelli tire are available; so how closely the two constructions compare or what effect the Pirelli tire will have on the Seiberling patent application is not known at this time.

In announcing the tire, J. P. Seiberling, company president, said, "Nylon gives the tire extra strength, and rayon provides riding comfort and reduced vibration."

He also noted that the company has trade marked the name "Nytex" for this construction. It will be available first in the first-quality "Super Service" line with price about midway of the differential between an all-nylon and an all-rayon original-equipment tire.

Further details on the background and development of the tire were given by Harry P. Schrank, executive vice president, who pointed out that both cords are capable of producing an excellent tire, but that nylon can produce a stronger tire, depending upon the quality policy of the tire manufacturer. Nylon, however, is subject to "flat spotting" when allowed to stand. The thermoplastic nature of the nylon causes it to become fixed in the shape of the part of the tire in contact with the ground as it cools back to ambient temperature from the running temperature.

In most areas this effect wears off after a mile or so of operation. In Canada, where the gleam of this idea really took shape, it is not unknown for this "flat spot" to remain for considerable distances during periods of really cold weather. Thus the extra strength of nylon cord tires to meet the demands of rough roads was forsaken by many who objected to the "thump."

A. L. McMullen, vice president and factory manager of Seiberling of Canada, had played with the idea of combining plies of the two cords for some time and made up some sample tires for trials. His results were sufficiently satisfactory that he was able to convince the somewhat skeptical engineers in the Akron development labs that further work should be done. Now, as Schrank reports, these formerly skeptical research and development people have been very amazed at the results of the years' testing, are quite satisfied, and are putting what they call a "Super Nytex" tire through numerous tests.

J. P. Seiberling shows a cut-away model of the new "Nytex" tire which is made with two plies of nylon and two plies of rayon

The tire is of four-ply construction. The two inner plies are of nylon since it is the inner plies which rupture first under a high impact. In the outer two plies, where resistance to separation is more important than superior strength, and where cords rupture only if the inner plies break, rayon is used.

In addition to virtual elimination of the flat spotting problem, the new tire runs as quietly as one made from all rayon. An all-nylon cord tire, by contrast, tends to

transmit more of the drumlike tire noise from irregularities, which appear in the road, such as expansion joints.

Dynamic impact tests run by Seiberling, and confirmed by a cord supplier, give results which might be expected. The "Nytex" tire is more resistant to impact breaks than an all-rayon cord tire, but not quite so resistant as an all-nylon cord tire. An unexpected plus turned up by field tests is that a "Nytex" tire retains more of its original strength after running than when either rayon or nylon is used alone. This effect, not really believed until retests were run, has not been satisfactorily explained scientifically, but Mr. Seiberling expressed an opinion that in some way the two cords were supporting each other during the tire's life, thus cutting down fatigue effects.

In the year of testing the tire on test fleets, taxis, salesmen's cars, and over the unfinished trans-Canada highway, Seiberling results show the "Nytex" tire to have lower heat build-up than rayon and equal to nylon; to be as quiet running as a rayon tire; and to match the tread wear and channel cracking of either single-cord construction tire.

Mr. Schrank warns, however, that although the basic idea of putting two plies of each cord in a tire seems simple, it is not so easily done as it might sound. You cannot just take two plies of nylon and two plies of rayon and get the results he reported. He did say, however, that the results obtained by Sieberling so far have encouraged the company to think that further developments now under way will produce better and better results, leading to "Nytex" tires having still greater advantages.

Cis-1,4 Polyisoprene

(Continued from page 74)

shows increasing heat generation with increasing 3,4 content.

From the foregoing discussion and examples it can be concluded that the 3,4 structure in *cis*-1,4 polyisoprene is detrimental both to raw and vulcanizate physical properties. By adding heterogeneity to the polymer chain in the form of 3,4 units, the desirable properties generally associated with *Hevea* (such as tack, high gum tensiles, etc.) are rapidly lost as the 3,4 content is increased. The loss in vulcanizate properties with increasing 3,4 content can be attributed to the reduction of intermolecular forces with increasing disorder of the polymer chains.

Summary and Conclusions

The preceding discussion has shown the effects of certain polymerization variables upon the production of isoprene polymers made by Ziegler catalysis.

Synthetic *cis*-1,4 polyisoprene can be made to have both the raw and vulcanizate properties of *Hevea* rubber provided the polymerization is carried out under conditions that give rise to: (1) high molecular weight, (2) relatively loose gel structure, and (3) not over 5% 3,4 structure. Variations in any of these requisites result, to a greater or less degree, in poorer typical rubber properties, for example: (1) lower gum tensile strength, (2) higher Goodrich flexometer temperature rise, (3) poorer 100° C. physical properties, and (4) less dry tack.

Of the systems known to us, only Ziegler catalysis produced synthetic *cis*-1,4 polyisoprene meeting all of the above requirements. By utilizing all the essential information, a synthetic replacement for natural rubber has become a reality. This was borne out when heavy-duty truck tires were put on test; they gave 95% or more of the performance of *Hevea* rubber controls.

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Self-Bonding Silicone Rubber

(Continued from page 75)

range of 0.4-0.8% by weight has produced optimum results in lab study.

First of Series

Although the method used to provide this new self-bonding material can be applied to other silicone rubber compounds and will be in the near future, the first of the series has been designated General Electric SE-5504U and falls in the high-strength Class 500 silicone rubber possessing excellent tensile, elongation, and tear strength, with moderate compression set. Typical physical properties are indicated as tensile, 1500 psi.; elongation, 550%; tear, 200 psi.; and compression set, 45% after 22 hours at 300° F. These properties were obtained on cure of 24 hours at 350° F.

Goodyear Confident of Nylon's Future As Major Factor in Tire Cord Industry

Company pushes research for yarns with greater fatigue resistance, adhesion, thermal shrinkage

ALTHOUGH new synthetic fibers now being developed may eventually take over the tire cord market, Goodyear Tire & Rubber Co., Akron, O., is betting a large share of its research dollars that nylon will still be the big factor in the tire cord industry for a long while.

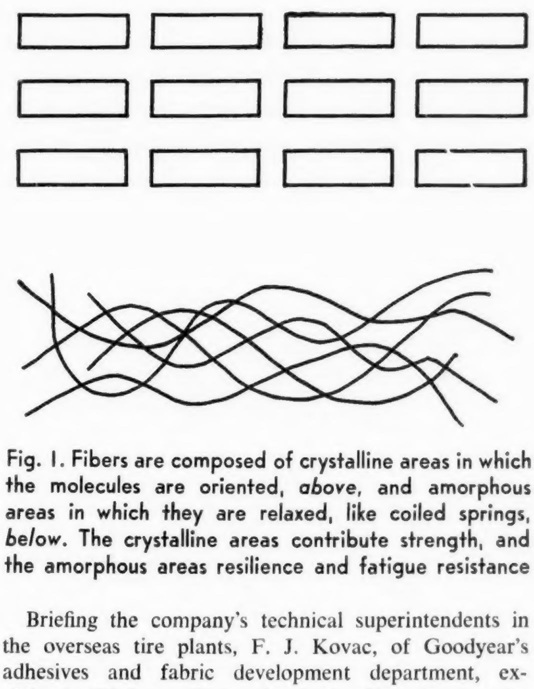


Fig. 1. Fibers are composed of crystalline areas in which the molecules are oriented, *above*, and amorphous areas in which they are relaxed, like coiled springs, *below*. The crystalline areas contribute strength, and the amorphous areas resilience and fatigue resistance

Briefing the company's technical superintendents in the overseas tire plants, F. J. Kovac, of Goodyear's adhesives and fabric development department, explained, "Nylon will be the basic fiber in the tire industry for years to come. Therefore development on new nylons is very important and takes more of our development time than work on new fibers."

Tire Firms Set Research Objectives

He explained that tire manufacturers, by specifying what properties they want in a tire cord, in effect design the yarn. It is up to the fiber manufacturers to do the research necessary to develop the desired product.

By improving the yarn, the fiber manufacturer can produce a product that differs markedly from the original. Under the Goodyear system the original nylon used for tires is described as First Order Nylon (Du Pont 300 and Chemstrand HB), and the heat-resistant type (Du Pont 700, Chemstrand RHB, and Allied Caprolan) is described as Second Order Nylon. Kovac told the superintendents that a Third Order Nylon would be available in the United States this year, with 25% better fatigue resistance, 25% better adhesion, and 10% better heat resistance than Second Order Nylon.

Almost simultaneously Chemstrand Corp., New York, N. Y., announced an FRN nylon with 100% better fatigue resistance than that of present yarns. The company, however, made no claims on improved heat resistance and adhesion for the yarn.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., is also making a new yarn, but has not yet revealed details.

Of major importance, Kovac said, is that Goodyear is stressing other factors than tensile strength in its research into new nylons. It will welcome yarns with increased tensile strength, but not at a sacrifice of other important qualities such as fatigue resistance. Since nylon already has high strength, Goodyear is directing its main efforts to improving such qualities as resilience and thermal shrinkage, he explained.

Tensile Strength Isn't Everything

A nylon can have higher tensile strength and still be poorer for tires than another nylon, he pointed out.

Bruise resistance of a tire depends on its energy to break, which rests not only on fiber strength, but on elongation to break.

$$\text{Energy} = \frac{\text{Strength (gpd)} \times \text{Elong @ Break}}{2}$$

or

$$\text{Toughness} = \frac{\text{Area under Stress-Strain Curve}}{\text{Denier}}$$

Increasing the draw ratio of nylon, that is, the ratio of denier of the yarn before stretching to the denier after stretching, is the simplest way of achieving high strength, but this reduces elongation to break and thus energy to break and fatigue resistance. Here is an example:

	Reg. Nylon	Exp. Nylon
Strength (lbs.)	30	34
Strength (gpd)	7.4	8.4
Elong @ break (%)	25	21.5
Energy	92	90
Fatigue resistance	100	70

The stronger experimental nylon has less energy to break and poorer fatigue resistance.

On the same basis it can be shown why one of the two main types of nylon used for tire cord, Nylon 6, can make a tougher tire than the other type, Nylon 66, even though its tensile strength is lower.

	66	6
Strength (lbs.)	30	28.5
Strength (gpd)	7.4	6.8
Elong @ break (%)	25.0	30.5
energy	92	103
Fatigue resistance	100	125

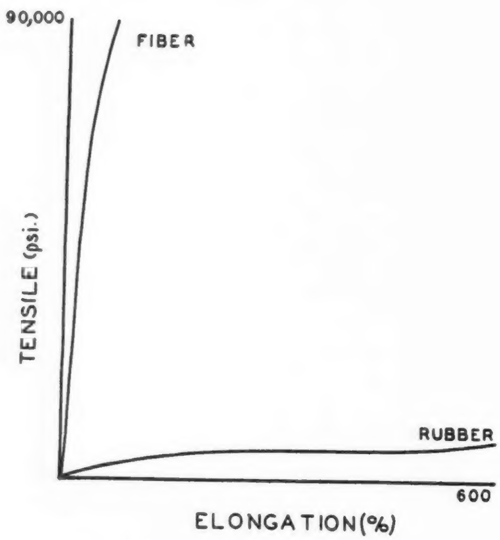


Fig. 2. Most fabrics have a considerably higher modulus than rubber, as shown here. Nylon, because it has a lower modulus than most fibers, is considered to be a good match for rubber in tire fabrics

Kovac explained that this relation holds because a fiber structure is composed of both amorphous and crystalline areas. The crystalline areas are chain molecules which have been stretched out and which exhibit strong intermolecular forces and a high degree of order. This high degree of order gives high tensile strength. Since the molecules are stretched, however, they have a limited amount of elasticity and fatigue resistance.

In the amorphous areas, the chain molecules are in a relaxed state, like coiled springs. These areas have high elasticity and fatigue resistance. (Figure 1.)

Because both of these areas are important in nylon qualities, it is not desirable to increase crystallinity, and therefore tensile strength, out of proportion to the amorphous areas.

Thermal Shrinkage

In addition to high energy to break, nylon exhibits other characteristics which make it a good fiber for tire cord, Kovac said. Two of the most important are low modulus and thermal shrinkage.

Most fibers, he noted, have a considerably higher modulus than rubber. Nylon, because of its low modulus, or stress-strain curve, has a better dynamic match with rubber. Therefore, under the stresses of high-speed performance, nylon develops less shear forces between the rubber and the fiber. (Figure 2.)

Unlike most substances, which expand when heated and contract when cooled, nylon and rubber both exhibit the Joule effect; that is, they shrink when heated. This thermal shrinkage is the reason why nylon cord tires must be postinflated after vulcanization, since the nylon cord shrinks more than the rubber and must be stretched back to the proper size.

Thermal shrinkage, however, is one of nylon's advantages as a tire cord, Kovac declared. It tends to make the nylon toughen up at tire operating temperatures. In addition, the thermal shrinkage counterbalances the tendency of nylon to stretch under a load.

Goodyear data show that at 275° F. nylon has sufficient thermal shrinkage to balance growth tendencies, he revealed. If it were possible to achieve the amount of shrinkage at 175° F. that is now obtained at 275° F., growth might be eliminated as a factor in tire wear, he added. For that reason Goodyear is investigating ways of increasing thermal shrinkage at present temperatures, or getting the same amount of shrinkage at lower temperatures.

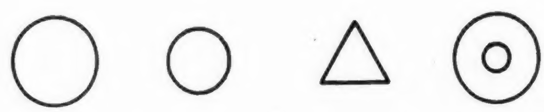


Fig. 3. Goodyear researchers are studying new sizes and shapes of yarn filaments in order to improve such properties of tire cord yarns as adhesion. The figure at left shows the cross-section of current filaments. Proposed are filaments half the size of normal, *second from left*, triangular, *second from right*, and hollow filaments

Improving Nylon Adhesion

Goodyear is also seeking ways to improve nylon's resilience, or power to snap back after being stretched, since this is what gives nylon its toughness when operating at high speeds under heavy loads. The company is also carrying out an enormous program to evaluate new chemicals and finishes for improved nylon adhesion, since no fabric is any stronger than its adhesion to the rubber of the tire.

Work is also being done on additives to improve heat resistance of nylon cord, he noted, although because of its lack of bulk compared to other fibers, a tire made with nylon cord runs cooler than other types of tires.

Kovac said that Goodyear is also interested in obtaining a nylon with a built-in adhesive finish, eliminating the necessity of applying an adhesive coating. This would make it possible to eliminate the present operation of dipping and stretching the fiber. The raw nylon would be twisted and woven in a dehumidified atmosphere, directly calendered, and built into the tire. Then it would be hot-stretched by postinflation.

In order to improve mechanical properties of nylon for tire use, Goodyear is investigating new sizes and shapes of filaments, Kovac explained. The company is looking into filaments half the size of normal, triangle-shaped filaments, and nylon with hollow filaments. Triangular fibers, for example, would not pack so closely together in a cord as round fibers and thus would be more adhesive than current round strands. Hollow fibers would be larger and therefore more adhesive than present fibers, but would weigh no more. (Figure 3.)

Licking Flatspotting Problem

Last, but not least, the company is looking for a way to solve the problem of flatspotting, one of the main reasons why auto companies are still reluctant to adopt nylon cord tires as original equipment. Flatspotting is the tendency of a nylon tire parked under load for a period of time to show deformation. This deformation causes bumpiness for a short while after the car is started. Although considerable work has been done to try to eliminate flatspotting in present nylons, it appears that a basic modification of the fiber must be made before the problem can be ended, he said.

Spinning the Yarn

When polymerization is complete, the viscous melt is pumped to a continuous spinning machine where it is extruded through a stainless-steel die. The die for 840 denier yarn has 140 orifices, giving a yarn with 140 filaments. From the die the yarn passes through a long cooling column, and then finish is added to the yarn, and it is wound on bobbins.

The final step is the drawing operation. The yarn is passed over a ceramic draw pin to orient the yarn and change it from an amorphous form in which the molecules tangle like straws in a haystack to an amorphous-crystalline form in which the molecules in the crystalline areas are lined up. Draw ratio is about 500%. That is, in order to obtain 840 denier nylon after drawing, the yarn producer must spin a yarn of about 4000 denier. The filament is not reduced in diameter immediately over its whole length. Instead, in a process known as neck formation, the reduction in diameter is concentrated at one point.

After drawing, the yarn is wound on pirns. The pirns are beamed, and the beamed yarn is shipped to the tire fabric mills to be made into tire cord.

Basically, there are two types of nylons, Kovac stated. The first is a polycondensation of diacids and diamines. This group includes Nylon 66, a polycondensation of adipic acid and hexamethylene diamine, and Nylon 610, a polycondensation of sebacic acid and hexamethylene diamine.

The other group, made by polycondensation of amino acids, includes Nylon 6, a polycondensation of caprolactam; Nylon 7, a polycondensation of cenanthiclactam; Nylon 9, a polycondensation of pelargoniclactam; Nylon 11, a polycondensation of undecanolactam; and Nylon 12, recently developed in Germany, a polycondensation of dodecanolactam.

Nylon 6 and Nylon 66 are the main fibers used for tires, although Nylon 7 is being used for tires in Russia, the speaker said.

Both Nylon 6 and Nylon 66 are normally made by a continuous polymerization process, although they can also be made by batch process, with polymer chips formed and remelted for spinning.

Sale-Leaseback Plan for Plant and Equipment

A new plan by which rubber companies can sell their existing plant and equipment and immediately lease it back for terms of from three to 12 years has been announced.

The plan was designed specifically for firms which have an over-large investment in fixed assets, and whose growth, as a result, was being hampered by tight working capital, according to Nationwide Leasing Co., Chicago, Ill., the company offering this plan to rubber manufacturers.

A special feature, as noted by Nationwide President Robert Sheridan, is that selected firms may sell, for cash, fully or partially depreciated equipment at book or greater than book value and lease it back. This is the first such plan ever developed for the rubber industry and includes, as other innovations, the inclusion of custom-built equipment and the availability of terms as long as 12 years, according to Sheridan.

Use of such sale-leaseback plans is reported to be expanding rapidly. In 1960, sale-leasebacks of plant and equipment totaled $340 million, of which equipment was listed as being $57 million for this period.

Any company which qualifies may apply for the plan which will include every type of production and office equipment. Minimum amount that will be considered under the plan is $25,000. There is no maximum except that the net worth of the company must be at least three times as much as the sum involved in the sale-leaseback.

Features of the plan include: equipment will be purchased by Nationwide for cash at book value and for selected firms at even higher prices; equipment will be immediately leased back to the company for terms from three to 12 years, depending on the amount and type of items covered; no security deposit is required; level quarterly payments, unless other schedules are requested; and custom-built equipment is included.

The company must have a net worth of at least $100,000; must have a history of profitable operations; must submit an appraisal of the current value of equipment involved; and must show evidence of a competent management group.

meetings and reports

Akron Rubber Group Panel Covers Various Aspects of Radiation and Rubber

The ABC's, degradation, vulcanization, and analysis and measurement of rubber by radiation were covered by a panel at the January meeting of the Akron Rubber Group. More than 350 members and guests attended this session.

In his introduction to the subject Moderator R. F. Anderson, The B. F. Goodrich Co., suggested that the rubber industry was not unaware of the impact that atomic energy may have upon rubber products and processes. He noted that radiation was already being employed in production operations in rubber plants, but that this is only the beginning of the applications of atomic energy to rubber; the industry still has much to learn.

Basic Types

The basic types of radiation were covered by John W. Liska, The Firestone Tire & Rubber Co., in his talk, "The ABC's of Radiation." He discussed three types of radiant energy primarily: beta radiation, which has been in use since before the atom bomb and consists of high-speed electrons; neutrons; and gamma radiation, which were merely laboratory curiosities until the advent of nuclear reactors.

Each type of radiation may produce other types by interaction, but Mr. Liska limited himself to the primary effects of each. He covered each type with regard to source and energy, shielding problems, and certain other specific information. A further discussion of units of measurement and some common sources of radiation was also included.

Detrimental Effects

"It is important for rubber scientists and technologists to recognize that nuclear radiation induces both beneficial and detrimental effects in elastomers and rubber compounds," was the opening statement of J. W. Born, The B. F. Goodrich Co., in his paper "Radiation Degradation of Elastomers." Since the beneficial effects were to be covered in a later paper on the program, he limited his talk to the detrimental effects.

He stated that basically, nuclear radiation is simply another form of energy which can interact with elastomer molecules to cause physical and chemical changes. The most penetrating types of ionizing radiation, fast neutrons and gamma rays, produce similar effects in elastomers. Both cause the ejection of high-energy electrons from the atoms of the target material. These electrons, although secondary forms of radiation, become the principal agents of radiation damage because of their numbers and greater efficiency of interaction.

The speaker went on to describe the generally adverse effect of radiation on physical properties of rubber vulcanizates, some specific tests for the evaluation of radiation damage, resistance of various rubbers to radiation, and the compounding ideas which have been developed to date to obtain maximum service life under radiation exposure.

He concluded that radiation deterioration is a new and severe aging effect and will become increasingly more common. At present, compounding for radiation resistance is mostly art, but progress is being made in systemizing it. A premium-quality compound, properly cured for optimum specific service is required. Anti-rads, radiation-stable new elastomers, and practicable inert environments can improve radiation service life of rubber compounds. Born expects future developments to increase the radiation damage threshold from the present 10 to 20 megarads to 100 megarads or more.

Beneficial Effects

Some beneficial effects of radiation were covered by T. C. Gregson, Goodyear Tire & Rubber Co., speaking on "Radiation Vulcanization." He pointed out that the beneficial use of curing unvulcanized elastomers contrasts sharply with the stigma normally associated with nuclear radiation because of the undesirable damaging effects which it frequently induces.

Present experimental work is being done with rather expensive radiation sources, such as man-made cobalt 60, so as to be prepared to take advantage of the enormous quantities of cheap fission wastes which should be available in our nuclear power economy of the future. This is feasible since it is possible to translate results from one form of radiation to another.

This speaker discussed the effects of carbon black and other fillers as well as other ingredients such as vulcanization materials and antioxidants and antiozonants. Certain materials such as heavy metal fillers can help the vulcanization; while most vulcanizers and accelerators do not seem to be of much help. Radical scavengers and the antioxidants or antiozonants do interfere with radiation vulcanization.

There is some work which indicates a possibility of development of chemical sensitizers for radiation crosslinking although, obviously, little has been seen as yet in the literature. It is hoped that such chemicals might provide the means of obtaining the dual objectives of reducing radiation doses, and thereby costs, while also improving physical properties.

Considerable progress has been made in the area of radiation vulcanization, but much is still to be done. By and large, radiation vulcanization of general-purpose rubbers produces somewhat poorer quality vulcanizates than conventional counterparts. The opposite is often observed, however, in some specialty rubbers. Present costs are about ten times as high as conventional curing, but there is reason to believe that diligent research will overcome this economic barrier.

Testing Techniques

The choice of isotopes and the problems of use and shielding were two of the points brought out by G. I. Doering, Industrial Nucleonics Corp., in introducing "Radiation Techniques for

Radiation panel at Akron Rubber included *(left to right)* seated, G. I. Doering, T. C. Gregson, and J. W. Liska; *standing*, R. F. Anderson (moderator) and J. W. Born

Analysis and Measurement." He said that much can be done with radiation sources in testing, but that one must realize that radiation from isotopes is not all that we might wish it to be. There are limitations as to the variation of energy from such a force.

Among some actual uses of radiation for measurement in the rubber industry he gave as one of the oldest the Beta gage for measuring and controlling thickness of calenders during coating operations. This type of use was begun in 1951 and has proved itself many times to give actual cost savings.

Another use is that of level measurement of liquids or solids in tanks or bins. The source is mounted on one side of the vessel with detectors on the other. Material absorbing the ray will cause the detector to signal a full tank or bin. Lack of material will, of course, cause any empty signal to be given. A series of such installations may be used to indicate varying degrees of material level. While quite expensive to install, such systems are external and therefore not subject to the environment of the vessel. In addition, they are always accessible for maintenance, Doering further declared.

The ability of radiation sources and detectors to measure the density of a slurry or liquid in a pipe or vessel permits its use in production such as polymerization of SBR. It is thus possible to detect the proper time to stop the reaction.

Guyer After-Dinner Speaker

After dinner-speaker at the meeting was Dr. Tennyson Guyer, public relations director for Cooper Tire & Rubber Co., a member of the Ohio Senate, and described as Ohio's "Ambassador of Good Will." His talk was titled "Mandate for Tomorrow."

New Shell Butadiene

The properties of Shell Chemical Co.'s new polybutadiene rubber, now in the product development stage, were discussed by A. V. Snider, product development manager of Shell's synthetic rubber division, at the March 7 meeting of The Los Angeles Rubber Group, Inc.

There were 120 persons present for the technical meeting and 300 for the dinner following, both at the Biltmore Hotel. Leonard Firestone, president of the Firestone Tire & Rubber Co. of California, was elected an honorary life member of Tlargi at this meeting. Six of the Group's 10 life members were present.

Snider explained that Shell Butadiene Rubber has high structural purity and ability to crystallize, with resilience better than that of natural rubber and abrasion resistance and low-temperature flexibility superior to those of both natural rubber and SBR. Shell's new rubber will also tolerate higher-than-normal filler loadings and has age resistance and thermal stability comparable to those of SBR, the speaker said.

He further declared that Shell feels its Butadiene Rubber should be blended with about 25 natural rubber for processing. Shell Butadiene Rubber is more resistant to shear and oxidative breakdown than natural rubber, giving a stabilizing influence on compound plasticity, he added. The polymer requires no breakdown prior to blending and compounding, and use of chemical plasticizers is therefore unnecessary and should be avoided, since it results in gelation, loss of structural purity, and damage to quality of the vulcanizate, Snider said. Although it has been found advantageous to employ processing aids, acidic processing aids should be avoided, as they promote continued cross-linking, he warned.

Left to right: Frank B. Smith, chairman, Connecticut Rubber Group, and E. L. Borg, speaker at the February meeting, both of Naugatuck Chemical Division

High Solids SBR Latex Described for Conn. RG

"High Solids SBR Latex by a Chemical Promoted Agglomeration" was the subject of the Connecticut Rubber Group's winter meeting, which took place February 17, at Rapp's Paradise Inn, Ansonia, Conn.

E. L. Borg, Naugatuck Chemical Division, United States Rubber Co., told the gathering of 176 that because polymerization of small particle synthetic latices is more rapid than that of high solids, large particle synthetic rubber latices, the former are useful in such applications as foam sponge. High molecular weight chemicals like poly(vinyl methylether) are used to promote agglomeration of the small particles to the large size required in high solids applications.

Ontario Group Meets

The annual joint meeting of the Ontario Rubber Group and the Wellington Waterloo Section of the Chemical Institute of Canada was held at Walper House, Kitchener, Ont., Canada, on March 14. It was attended by 170 members and guests, the largest number ever to gather at an ORG meeting.

The speaker, P. M. Nichols, United States Rubber Co., presented a paper on "Processibility of Synthetic Polyisoprene," which compared the processing of polyisoprene with natural rubber and showed the relation of processibility to polymer properties measurable in the laboratory.

ASTM Committee D-24 Adds HAFF, ISFF, And SAFF to Carbon Black Nomenclature

Nomenclature recommendations for the new low-structure blacks were among the various items of business at the committee week meeting of ASTM Committee D-24 on Carbon Black and its subcommittees held in Cincinnati on January 31.

The committee also approved a new tentative method for sampling bulk shipments of carbon black. This method will now be letter-balloted to the entire committee and, if approved, will then be published.

The letter-ballot will also contain a revision to tentative specification D 1765-60T, Specification for Carbon Blacks Used in Rubber Products. It has been found that the modulus limits for GPF needed to be revised, and new values were proposed.

Other continuing work was reported in the subcommittee meetings and will be found in the minutes of those meetings which follow.

Subcommittee 1—Chemical Tests. J. F. Svetlik, chairman. The mass strength test for pelleted carbon black using the hydraulically operated equipment was letter-balloted. Twenty-three affirmative, four negative, and 20 not-voting ballots were received. Those voting negatively were apprehensive about the reproducibility of the test. T. K. Cox, Western Electric Co., suggested that the equipment could be modified very simply to permit direct weighing of the applied load rather than relying on a calibrated air gage. Since the test, as originally described and voted upon, was not completely acceptable to everyone without further information, a program was outlined to test the reproducibility.

J. E. Smith, J. M. Huber Corp., agreed to prepare blended samples of SRF, HAF, FEF, and ISAF type of carbon blacks covering the pack point range of 10 to 70 plus pounds and distribute these in the Borger, Tex., area. He will submit samples directly to Phillips Chemical Co., Huber, and Cabot Corp. for testing and will ship samples to Columbian Carbon Co. at Munroe, La., and to Witco Chemical Co. at Akron, O. When the samples arrive at Akron, Witco will blend the samples again and submit portions to Goodyear Tire & Rubber Co., Inc., United Carbon Co., Inc., and Western Electric. After each participant has obtained test results on one or both types of equipment, they will report the results to J. F. Svetlik for tabulation and analysis.

A question was raised concerning the force with which the sieve residue should be rubbed to rub off loose carbon black and yet insure that the residue is not broken up and lost. This subject will be studied by B. F. Goodrich and various carbon black producers, individually, and perhaps by the June meeting sufficient data may be available to add an editorial note to the procedure for sieve residue.

Subcommittee 2—Chemical Tests. L. G. Mason, chairman. Since ASTM headquarters had referred a tentative method for determining carbon black content in ethylene plastics, ASTM D 1603-60T, Method of Test for Carbon Black in Ethylene Plastics (Tentative), under the jurisdiction of Committee D-20, to Committee D-24 for review, it was referred to Subcommittee 2 by the chairman. The subcommittee suggested that it be submitted to the Chemical Test Section of Subcommitee 13, Committee D-11.

Subcommittee 3—Optical Tests. John E. Smith, chairman. A. E. Hicks, chairman of Task Group 12 in Subcommittee 15 of Committee D-11, reported by letter the status of the work on the problem of migration stain of light-colored rubber compounds. The task group is attempting to establish correlation between the Test for Discoloration of Benzene by Carbon Black (Tentative), D 1618-58T, and a method of measuring staining tendencies of carbon black in tire carcass compounds through white sidewalls (migration stain). This task group is also trying to set up rubber standards to be used for the measurement of the degree of stain by reflectance measurements. The report of the recent interlaboratory test on the color of light-colored rubber compounds is nearing completion.

It was recommended that D 1618-58T be continued as a tentative method until such time as the task group is completed.

Subcommittee 4 — Nomenclature of Carbon Blacks. J. H. Gifford, chairman. A new system for nomenclature of carbon blacks was suggested, and it was decided to send this in the form of a questionnaire to D-24 members for comments. It was agreed to recommend the following names for Neotex and Regal blacks in the presently used system of nomenclature:

ASTM	Trade Name
HAFF (high abrasion fine furnace)	Neotex 130, Regal 600
ISFF (intermediate super fine furnace)	Neotex 100, Regal 300
SAFF (super abrasion fine furnace)	Neotex 150

It was further agreed to present in the questionnaire the present system of nomenclature for all grades of carbon black used in rubber. The Carbon Black Packaging Committee pointed out the advantages of having a universal code for each grade of carbon black.

Subcommittee 5—Sampling. John E. Smith, acting chairman. The first item discussed was a proposed editorial change in the Methods for Sampling of Packaged Shipments of Carbon Blacks (Tentative), D 1799-60T. This editorial change, accepted by vote of the subcommittee, stated that "samples for determination of heating loss should be taken both at the end and the geometric center of the bag and the heating loss value reported as the average result from these two locations." Sampling from the end of the bag was defined as "removing the first inch of black and sampling from the second inch from the end of the bag." The method for heating loss (Subcommittee 2) should be revised to refer to these sampling procedures in D-1799.

Copies of the new proposed tentative Methods of Sampling Bulk Shipments were distributed. A report on the statistical studies used in developing this procedure was presented. These studies were made by statisticians of Goodrich and Phillips. Statistical data from these studies were included in the proposed procedure as supporting data for the sampling procedure.

It was decided by the subcommittee, after discussion, that the proposed procedure be rewritten in ASTM format. The statistical report and data were to be attached to the letter-ballot as explanatory data instead of including in the procedure. With this change in form it is recommended that the method be letter-balloted jointly in Subcommittee 5 and Committee D-24.

Discussion on specifications of fines on bag samples showed that members felt that decisions on these specifications should await further study.

Subcommittee 7 — Specifications for Carbon Blacks. J. H. Gifford, chairman. The question of heat loss was reviewed, and it was agreed to send a questionnaire to the members of this committee suggesting heat loss limits that were previously generally acceptable to this committee.

Experience has indicated that higher modulus limits are needed for GPF carbon black. It was agreed to recommend a letter-ballot to revise Table 2 of D 1765-60T, Specification for Carbon Blacks Used in Rubber Products, to increase the 15-minute cure modulus limits for GPF carbon black by 125 psi. and to increase the 30-minute cure modulus limit by 150 psi. The new limits on stress at 300% elongation would be —400 to +100 psi. for the 15-minute cure and —525 to —25 psi. for the 30-minute cure.

SRG Hears Metal Oxide And Retreading Talks

Some aspects of the role played by magnesium oxide and zinc oxide in rubber compounding were covered in one panel session and problems regarding equipment and processes in retreading in another panel at the meeting of the Southern Rubber Group in Dallas, Tex. January 20 and 21. Almost 200 members attended along with well over 150 wives to make the meeting a great social success as well as technical success.

Role of Metal Oxide

The role of magnesium oxides was presented by W. H. Deis, Merck Marine Magnesium Division, in his talk, "Magnesium Oxides in Elastomers." He discussed the two general types of magnesium oxide available to the rubber compounder. They differ in purity, surface area, and reactivity toward acid. The heavy calcined grade is inactive and generally impure and was one of the first inorganic accelerators for natural rubber. It finds limited use in today's compounding. It does give a denser cured product in highly loaded clay compounds. The other grade is the active MgO which is a necessary and important ingredient for many elastomers.

The speaker described the chemical and physical properties of MgO which are of interest to the compounder and the reasons for this interest.

The paper went into considerable detail on the use of MgO in various neoprenes, "Hypalon," fluoroelastomers, chlorobutyl, butyl, SBR, and use with peroxide cures.

The "Role of Zinc Oxide in Compounding Rubber Elastomers" was discussed by Marvin Coulter, American Zinc Sales Co. He covered the production of zinc oxide and the effect of different methods of production on the finished product. Here again, as in the previous paper, the author discussed the chemical and physical properties of ZnO and the relation of these properties to the use of ZnO in compounding. He also spoke of the effect of ZnO in various types of rubbers, with some data presentations showing typical results in these rubbers.

Tread Rubber Problems

"Retreading Problems" from the point of view of the manufacturer of retreading equipment were presented by E. J. Wagner, Super Mold Corp. and former retreading editor of *Modern Tire Dealer Magazine*.

The major portion of Mr. Wagner's talk covered a discussion of the problems of designing the matrix for producing retreads where the dimensions of the carcass being used must be determined to get a proper fit with the matrix. The gathering of these worn tire data in sufficient quantity to insure that final computations will reflect dimensions that are currently being found in the field is a real problem. The speaker also described in some detail the statistical methods used to plot and calculate the necessary information needed for good matrix design.

In using the matrix, the retreader is furnished with a matrix specification sheet which lists the matrix dimensional characteristics, the recommended curing bag and rim, and a suggested tread rubber die size. A major area of trouble develops, however, if the retreader does not actually check out the dimensions of the tread rubber against the dimensions of the matrix since there may be variation between suppliers of tread rubber even though it is being made from the suggested die.

Wagner touched also on the problem of tread separation which is often blamed on the tread rubber or cushion gum. He suggested that although there may be instances where these materials are at fault, the greater number of instances of tread separation are due to faulty shop practices by the retreader.

"Manufacture of Tread Rubber" was the topic presented by A. J. Jones, Gates Rubber Co. He lists the major factors in compounding and manufacturing tread rubber as uniformity, safe extrusion, long shelf life, pliability, cushion tack, balanced cure, crack resistance, and separation resistance.

He presented data to show the effect of polymer, acceleration system, and variations of accelerator and sulfur on the shelf life of tread rubber compounds. In addition, this speaker went into the selection of carbon black and said that HAF is probably the most popular. Some FEF is used, but at a sacrifice of tread wear and tear resistance. At the other extreme ISAF may be used for extra wear. Some SAF is used, but mixing and extrusion problems prevent wider adoption.

The development of a satisfactory cushion gum is another major compounding problem, according to Jack Jones. Tack is all important, but maximum tack does not go hand in hand with satisfactory cured properties.

Following compound development, he then went into the necessary tests to prove out a new compound for practical use. These tests include shelf life, changes during storage, wheel tests (laboratory), fleet and commercial tests, tear resistance, curing variations, and, finally, the acid test, the use of the compound by retreading shops without supervision to see if it can be handled by the retreader without difficulty.

Southern Rubber Group panel on metal oxides was *(left to right)* William Deis and Marvin Coulter with Joe Stonis as moderator

SRG panel discussing retreading problems consisted of *(left to right)* Jack Jones and Ed Wagner with Grady Oaks serving as moderator

washington report

By JOHN F. KING

Tax Increases on Tires, Tubes, and Tread Rubber Opposed by Industry

A unified rubber industry—manufacturers, dealers, and retreaders—joined forces to oppose the Kennedy Administration's proposals for financing the Federal Interstate Highway program in late March.

House action on the Administration package, which will be followed by Senate consideration, is expected in early April with the prospects uncertain that the new President will have his way with his plan to increase sharply user taxes to underwrite the national roads program.

Appearing before the tax-writing House Ways and Means Committee on March 21, all major segments of the rubber manufacturing and processing industry registered stiff opposition to the President's proposals to finance the highway program.

RMA Offers Plan

On the behalf of the tire, tube, and tread rubber makers, The Rubber Manufacturers Association, Inc., represented at the hearing by Ross R. Ormsby, offered Congress a substitute plan for completing the road-building program on schedule without increasing highway user taxes.

Key to the industry plan is the assignment of a limited amount of highway use taxes, which now are diverted to meet the cost of other federal expenses, to the highway program. Nearly $58 billion in highway user taxes will be collected over the next 11 years, which is the current highway construction schedule, the RMA president pointed out.

He said that with about $36.7 billion now earmarked for highway programs, Congress has only to earmark $4.9 billion of the $21.2 billion balance in user taxes for the General Fund for construction needs. He said this would suffice to put the total highway program back on schedule. Ormsby added that this approach would leave over $16 billion now collected in user taxes unearmarked in the General Fund to finance other, non-highway federal projects.

The RMA substitute would, if accepted in whole or in part, revamp President Kennedy's controversial excise tax plan to finance the massive road-building program over the next decade. Apart from stiff user tax increases which the Kennedy package would impose on large trucks plying the nation's roadways, it also would raise the levy on tires and tubes from 8¢ to 10¢ a pound; while the camelback excise would soar from 3¢ to 10¢ a pound. The President's program also calls for continuation of the 4¢ per gallon gasoline tax and higher levies on diesel-truck fuel.

Ormsby contended the proposed new taxes on rubber products—of 25 and 233% for tires/tubes and tread rubber, respectively—would impose an "onerous burden" on all rubber industry customers. Some truckers and retreaders, he asserted, would be driven out of business.

The RMA spokesman told the Committee that 63% of the proposed 25% tax increase on tires and 61% of the 233% increase on tread rubber would come out of the pockets of passenger-car owners. Another 16% would come from the owners of small trucks, he said, adding that these very same groups absorbed a 60% hike in tire taxes and an additional 3¢-per-pound tax on tread rubber when the $41 billion highway program was launched in 1956.

RMA's alternative proposals, Ormsby said, would (1) provide funds for completing the highway system on schedule; (2) enable Congress to settle financing problems for the life of the program, instead of having it consider periodic revisions in financing and construction schedules; (3) avoid a boost in present user tax levels; (4) free sufficient Highway Trust Funds to provide 55% of the money needed for state road building supplementary to the highway program; and (5) prevent further federal "encroachments" on the tax resources of the individual states.

Retreaders Fear Losses

Following Ormsby to the witness stand was W. W. Marsh, executive secretary of the National Tire Dealers & Retreaders Association, spokesman for the independent distributor organization in the tire and tube field. The whopping increase in tax proposed for their main raw material—camelback—would seriously disadvantage members of his organization in trying to market their products and services in competition with cheaper line new tires, Marsh said.

He harked back to NDTRA's position on the 3¢-per-pound tax imposed under the 1956 highway financing bill, when the independents told Congress that even that modest levy on tread rubber "would increase the sale and use of cheap, low-quality new tires." Such tires now supply 20% of the automobile tire replacement market, he asserted, warning that if there is another boost in the levy on retread rubber, low-income group consumers "will be forced to buy these $8.88 new tires at a considerable sacrifice in safety, performance and endurance. . . .

"The average retreaded passenger tire uses in excess of nine pounds of rubber in the retreading operation," Marsh explained to the Committee. "Thus, from a present tax of approximately 27¢ the tax would increase to 90¢ per tire."

Yet at the same time, he continued, the 2¢-per-pound hike proposed for new tires would produce an increase in tax on cheap new tires averaging 19 pounds apiece of only 38¢. This can only widen the retreaders' competitive gap with new tires or lower the quality of retreaded tires if the retreader is to remain competitive, Marsh said.

Taking up Ormsby's warning that the tire-tube-camelback tax increases might drive some rubber processors out of

business, Marsh claimed the taxes would have a "drastic" effect on small business operators in the distribution of tires and related products. He noted that the bulk of NDTRA's membership can be properly classified as small businesses.

He wound up his presentation to the Committee with a plea that Congress leave the present excise tax on tread rubber unchanged. At its present level, he said the tax would produce as much revenue as the 7¢-a-pound tax increase would produce for no other reason than the fact it would permit independents to continue operating.

FTC Rules TBA Sales Contracts Illegal

The Federal Trade Commission has ruled that long-standing contracts between the nation's two largest rubber manufacturers and two major oil producers—under which the oil companies promote the sale of the rubber manufacturers' tires, batteries, and accessories (TBA)—are illegal.

FTC on March 15 ruled that the sales commission contracts between Goodyear Tire & Rubber Co. and Firestone Tire & Rubber Co. on the one hand and Atlantic Refining Co. and Shell Oil Co. on the other "have unlawfully injured competition in the distribution of TBA at the manufacturing, wholesale and retail levels."

The Commission issued "cease and desist" orders requiring all four companies to discontinue the sales commission arrangements "both among themselves or with any other companies." A third sales commission contract, between The B. F. Goodrich Co. and the Texas Co., was not ruled upon, pending receipt of additional marketing data.

Companies to Appeal

The two rubber companies involved in the ruling promptly announced they would appeal the ruling, through the courts if necessary. O. E. Miles, Goodyear vice president, said it was the first time the sales commission plan, which is historic in the marketing of TBA, was ever held illegal.

"We intend to aggressively appeal the ruling," he declared.

Earl B. Hathaway, sales vice president at Firestone, said the FTC ruling would seriously cripple the business of its thousands of independent dealers and, in many cases, could put them out of business.

According to FTC's March 15 ruling, Shell and Atlantic are paid a commission by Firestone and Goodyear of between 7½ and 10% for assistance in obtaining TBA orders from Shell and Atlantic service stations or other dealers. These payments are made monthly to the two oil companies, which FTC said incur no expense in connection with the financing, warehousing, or delivery of the items.

Under these arrangements, Atlantic was paid \$506,199 by Firestone and \$557,559 by Goodyear on TBA sales of \$5,562,936 and \$5,700,121, respectively, in 1955. From 1950 to 1957, Firestone's sales to Shell outlets jumped from \$12 million to \$21 million, while Goodyear's rose from \$13 million to \$26 million. By 1957 these two rubber companies were paying Shell more than \$3.5 million commission annually on their combined sales of \$47 million.

Examiner's Ruling Rewritten

In ruling on these arrangements, the Commission rewrote the recommended decision of trial examiner Earl J. Kolb. Although he found that Shell and Atlantic used coercion and intimidation to force their dealers to buy "sponsored" Firestone and Goodyear TBA, Kolb did not rule that the sales commission contracts themselves were illegal. The examiner recommended only that the two oil companies discontinue using coercion and intimidation and would have left the contracts with the rubber companies stand.

In knocking out the contracts themselves as illegal, the full Commission said the coercive and intimidating activities Kolb found are "mere symptoms of a more fundamental restraint of trade inherent in the sales commission itself. The more dramatic and immediate impact of this system, to be sure, is upon retail service station dealers of Shell (and Atlantic) and other oil company dealers in a similar situation. Their freedom to buy and sell as independent merchants is shown to be less complete in practice than in theory.

"Yet from the point of view of the antitrust laws, it is the devastating competitive effects of the sales commission system on competitors of Firestone and Goodyear which raise the most grave questions" in the proceedings, the Commission said.

It added that one prime advantage received by Firestone and Goodyear from the contracts is their participating with each oil company's sales force in joint merchandising programs and promotional activities in advertising as well as the exchange of credit card facilities.

The decision is expected to spark new moves for divorcement of rubber and oil companies from the retail marketing end of the industry. George Burger of the National Federation of Independent Business, promptly urged "positive legislative action" to protect independents at production and distribution levels.

GSA Selling Small Lots of Stockpile NR

The three-month suspension of sales of natural rubber from the national stockpile ended, at least briefly, when the General Services Administration disclosed early in March that it had resumed sales on a small scale. Details on the amounts sold will not be released until early April, but news that GSA had begun selling again was of some interest to the rubber industry as a whole.

The renewed activity inspired speculation that GSA may change its ground rules to permit some selling even though the price of rubber on commercial markets slipped below 30¢ a pound. Under its existing sales program, GSA will not sell when the market price dips below 30¢; the long slide in prices last fall that took the market below 30¢ in December brought the halt in sales.

There is some belief that simply to prevent deterioration the government is thinking of selling small amounts of rubber from the stockpile at prices below the 30¢ cutoff. This speculation takes into account the fact that even while regular sales of smoked sheet halted when the price dropped below the cutoff, GSA still had to get rid of about 1,400 pounds of crepe to prevent deterioration; this is permitted despite the cutoff point rule. The speculation is that GSA may decide to unload up to 2,500 tons a month at a reduced cutoff price of between 20 and 25¢ a pound.

FTC Still Concerned About Tire Pricing

The Federal Trade Commission's Bureau of Consultation is canvassing virtually all tire manufacturers and brand name tire dealers for information concerning their use of comparative retail price claims and how their guarantees are honored and prorated.

A letter from John R. Heim, Bureau director, is the second to go out to the industry requesting tire price- and guarantee-advertising since last August. FTC said that while some deceptive pricing practices have been voluntarily eliminated since late last summer, others still cause official worry.

"We have been informed," Heim said, "that some organizations sell a small percentage of their tires at 'no-trade-in' prices. It is our position that these few sales do not establish a usual retail price. It follows that comparisons using such prices are fictitious and consequently deceptive when used in advertising."

Regarding reports that some industry members are prorating guarantee ad-

justments on a fictitious price, Heim pointed out this practice is forbidden by both the Tire Advertising guides issued by FTC in the last year or so. Here is what FTC wants in the way of advertising information:

(1) A tire's actual selling price; (2) the customary retail price in the trade area, or (3) the advertisers' customary retail price in the recent, regular course of business.

FTC cautioned recipients of the notices that failure to comply voluntarily with the questionnaire may lead to investigation and formal action by the Commission.

Food Additives Bill Deadline Extended

The House-passed bill extending the effective date of the Food Additives Amendment which has bedeviled many rubber manufacturers is scheduled for clear sailing through the Senate in April.

The bill sailed through the House early in March after Food & Drug Commissioner George Larrick suggested that the legislation—which gives his agency power to grant extensions for compliance with the 1958 Food Additives bill beyond the statutory March 6 deadline—be changed to permit new compliance extensions on those products which already had received extensions beyond the old March 6 deadline.

With this extra authority added to the extender bill, FDA could grant the Special Rubber Industry Committee on Food Additives—which has been struggling to get a clean bill of health for a long list of rubber compounds which technically could be classified as food "additives"—additional time for work on the exemption petition the Committee submitted to FDA on January 4 of this year.

URW Seeks Automation Fund in New Contract

The United Rubber Workers Union's International Policy Committee decided on March 17 to press a broad program of job protection to combat the stepped-up use of automated production processes which the Union feels is costing jobs in the rubber industry.

The job protection program, along with the Union's previously announced goal of a "general wage increase," will serve as "guide posts" for new contract negotiations which began March 21 with Firestone Tire & Rubber Co. and Goodyear Tire & Rubber Co., URW said. The contract talks, which will be opened with other companies this spring, are expected to set the pattern of labor settlements within the industry in 1961.

Highlights of the Union's automation protection goals follow:

(1) A full employment economy; (2) shorter workweeks with no loss in weekly pay, retirement, and pension benefits, or overtime in "unusual or essential situations"; (3) double "early retirement" benefits for employes affected by plant closings; (4) severance awards; (5) vested pension awards; and (6) a joint union-management "automation fund" to put URW's 11-point job protection program into effect in all its aspects.

Regarding the Union's push for a general wage increase, International President George Burdon said no specific figures would be set as targets until URW completes a study of the industry's current financial situation.

"The companies may take a position that because of the recession this is not the year for a wage increase," Burdon said in a statement. "The published reports of near record earnings by the companies convinces us this is the year," he added.

CALENDAR of COMING EVENTS

April 18-21
Division of Rubber Chemistry, American Chemical Society. Brown Hotel, Louisville, Ky.

April 19
Quebec Rubber & Plastics Group.

April 21
Detroit Rubber & Plastics Group, Inc.

April 28
Chicago Rubber Group. Furniture Club, Chicago, Ill.

May 2
The Los Angeles Rubber Group, Inc.

May 8-13
ISO/TC 45. Milan, Italy.

May 12
Buffalo Rubber Group. International Meeting. Sheraton Brock Hotel, Niagara Falls, Ont., Canada.

May 19
Connecticut Rubber Group.

May 21-30
American Chemical Society, St. Louis.

June 1
New York Rubber Group. Outing. Old Cider Mill Grove, Union, N. J.

June 2
Quebec Rubber & Plastics Group. Golf Outing. Ste. Hyacinthe, P.Q., Canada.

June 7-8
Tlargi Foundation Second Annual Technical Conference. Mayfair Hotel, Los Angeles, Calif.

June 9-11
The Los Angeles Rubber Group, Inc. Summer Outing. Stardust Hotel, Las Vegas, Nev.

June 13
Buffalo Rubber Group. Outing. Lancaster Country Club.

June 16
Akron Rubber Group. Outing. Firestone Country Club.
Boston Rubber Group. Outing. Andover Country Club, Andover, Mass.

June 23
Detroit Rubber & Plastics Group, Inc.

June 23-24
Southern Rubber Group. Buena Vista Hotel, Biloxi, Miss.

June 25-30
American Society for Testing Materials. National Meeting. Chalfonte-Haddon Hall, Atlantic City, N. J.

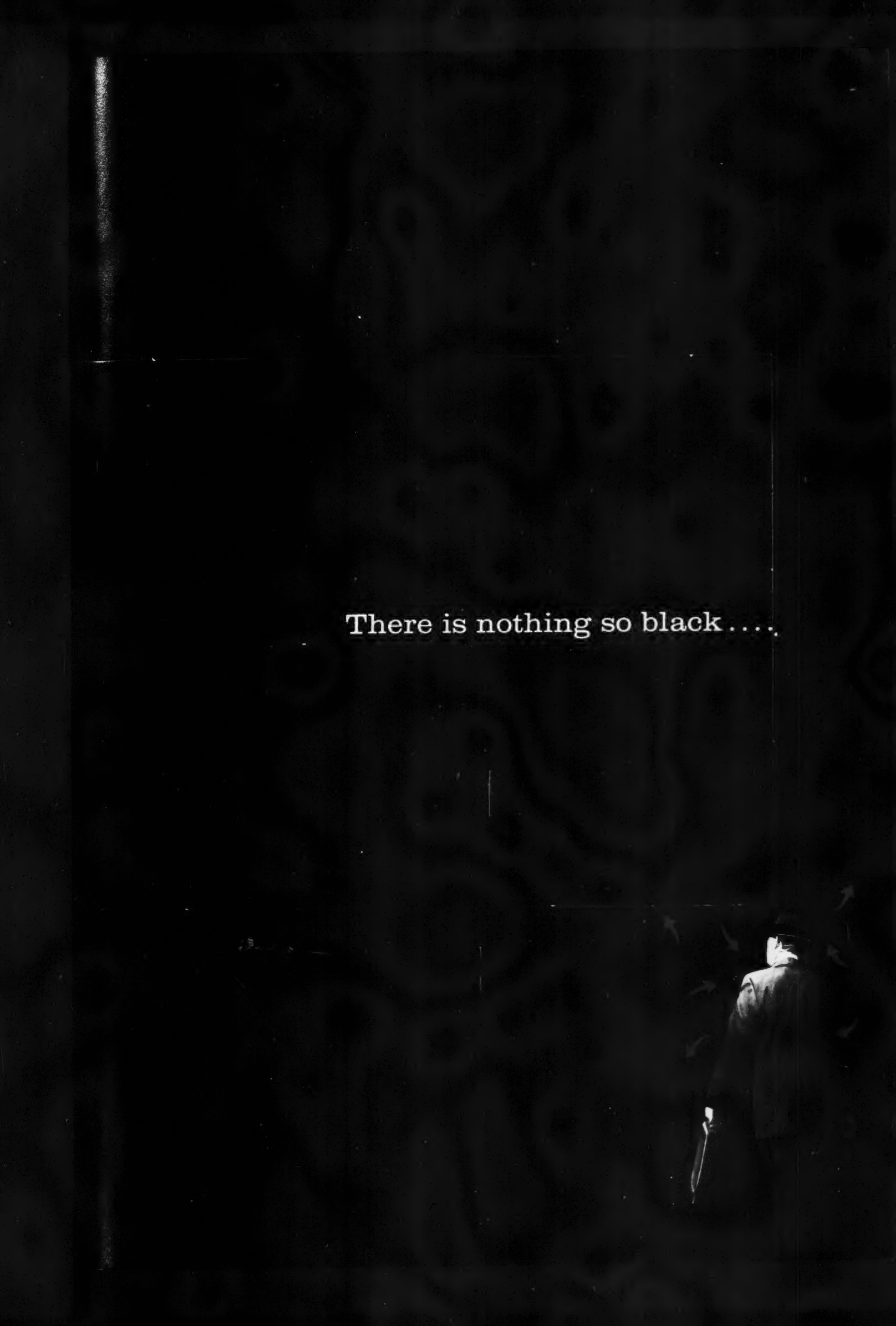
June 28-30
Committee D-11, ASTM. Atlantic City, N. J.

August 3-5
Chemical Institute of Canada. Canadian Chemical Conference and Exhibition. Queen Elizabeth Hotel, Montreal, P.Q., Canada.

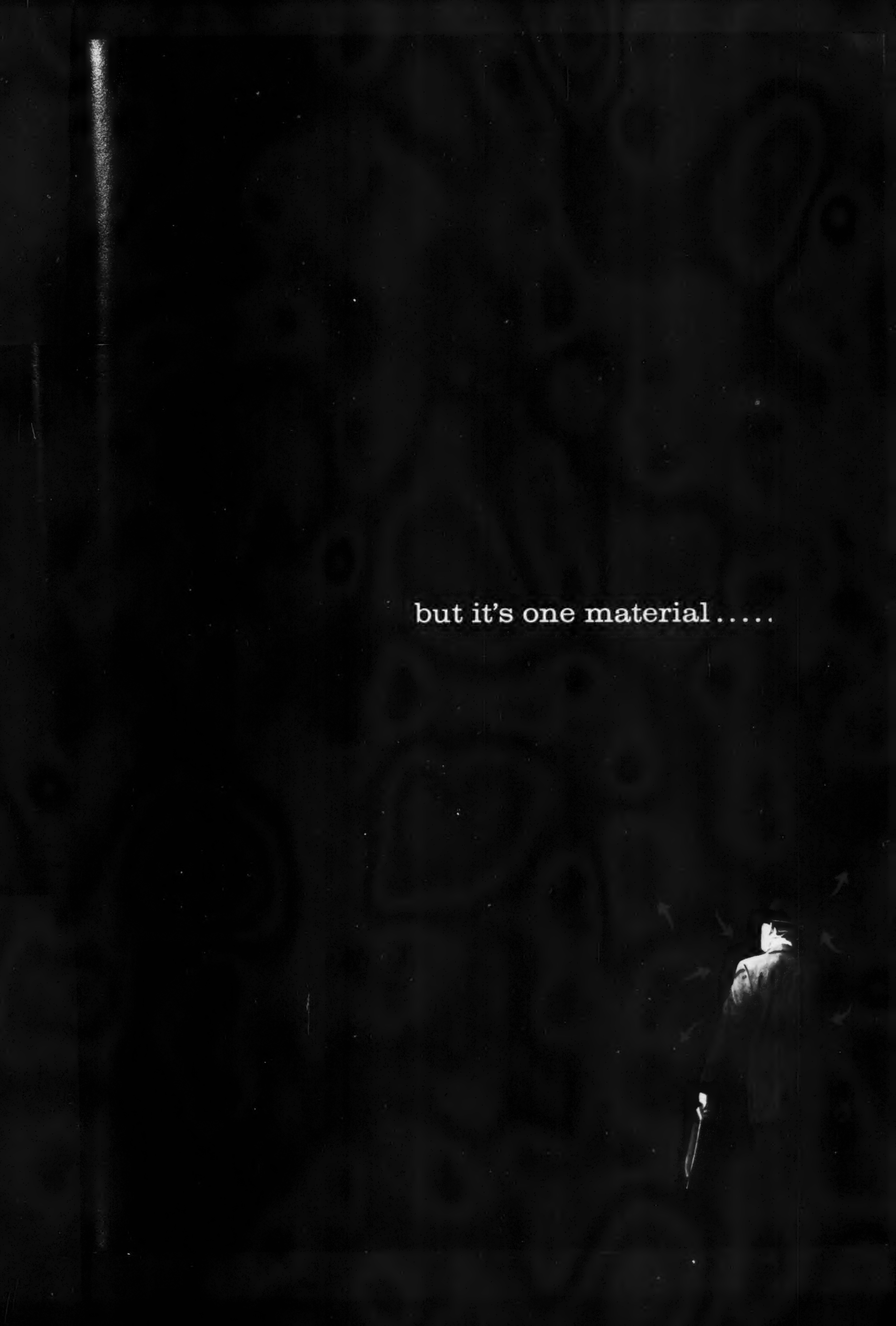
August 4
Division of Rubber Chemistry, Chemical Institute of Canada. Conference. Montreal, P.Q., Canada.

August 10
New York Rubber Group. Golf Outing. Scotch Plains and Echo Lake Country Clubs.

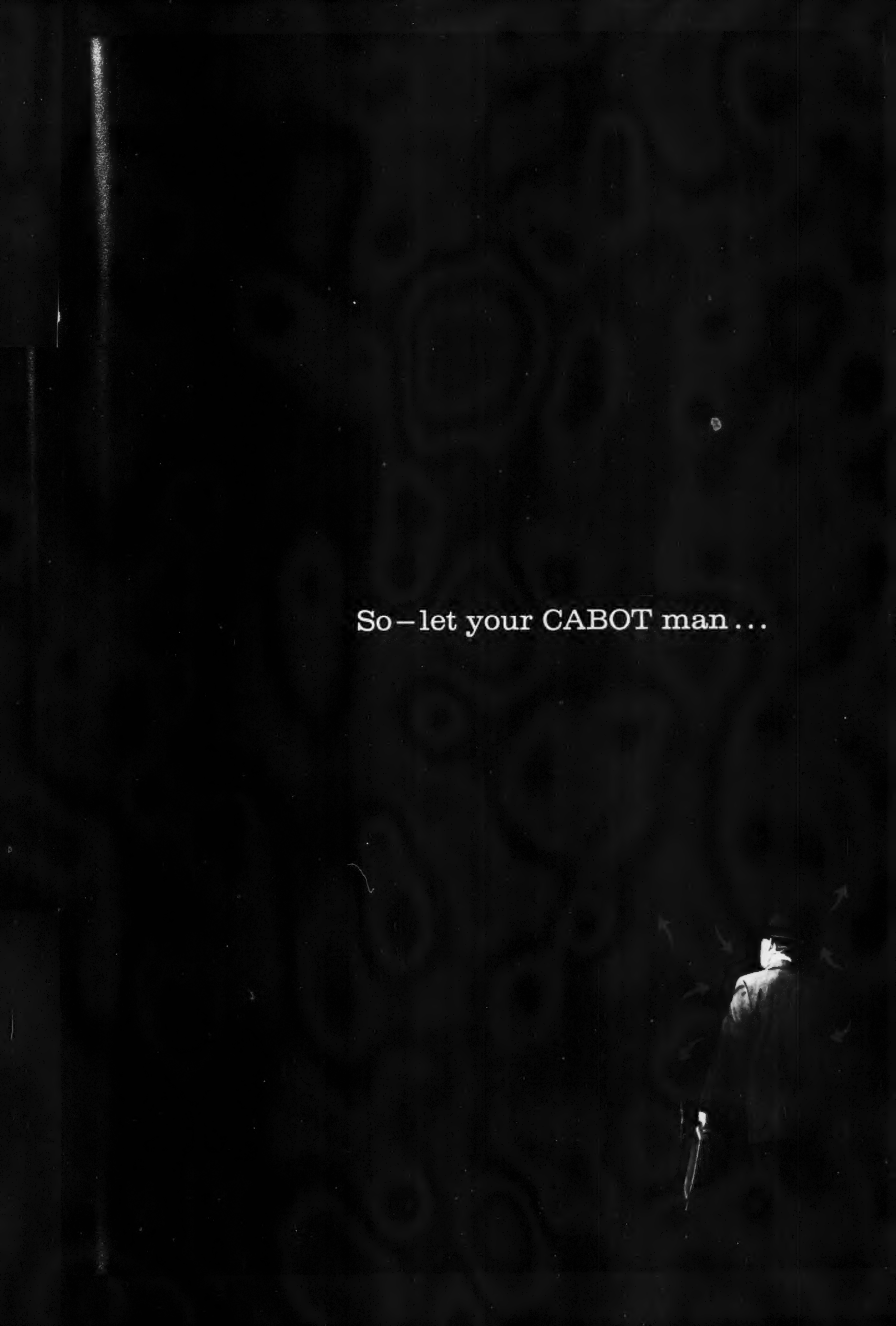
September 3-8
American Chemical Society. Chicago, Ill.


There is nothing so black....


. . . as Carbon Black


but it's one material.....

. . . you DON'T want to buy in the dark


So – let your CABOT man . . .

Lighten your problems....

CABOT CORPORATION

125 High Street, Boston 10, Massachusetts, U.S.A. LIberty 2-7300 Cable: CABLAK BOSTON

Sales representatives in all principal cities of the world

AKRON 8, OHIO — 518 Ohio Building — FRanklin 6-5168
CHICAGO 4, ILLINOIS — 141 West Jackson Boulevard — WEbster 9-6480
DALLAS, TEXAS — 1309 Main Street — RIverside 1-6117
LOS ANGELES 5, CALIFORNIA — 3350 Wilshire Boulevard — DUnkirk 2-7333
NEW BRUNSWICK, NEW JERSEY — 46 Bayard Street — KIlmer 5-1828
NEW YORK 17, NEW YORK — 60 East 42d Street — YUkon 6-7127

ARGENTINA — **Cabot Argentina S.A.I. yC.**, Sarmiento 930-2°A, Buenos Aires
CANADA — **Cabot Carbon of Canada, Ltd.**, 121 Richmond Street West, Toronto 1, Ontario
ENGLAND — **Cabot Carbon Limited**, 62 Brompton Road, London, S. W. 3
FRANCE — **Cabot France S.A.**, 45, rue de Courcelles, Paris 8
ITALY — **Cabot Italiana S.p.A.**, Via Larga 19, Milano
FRANCE — **Cabot Europa**, 45, rue de Courcelles, Paris 8
AUSTRALIA — **Australian Carbon Black Pty. Limited**, Millers Road, Altona, Victoria (jointly owned)

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industry news

Neotex Blacks Increase Tire Traction

Neotex low structure, low modulus blacks produce a tire which has substantially better traction on ice or hard packed snow than tires made with standard ISAF or HAF blacks, Columbian Carbon Co. announced March 28.

Columbian made its announcement after a series of tests conducted at Sundridge, Ont., Canada, near North Bay, in mid-March. Lloyd D. Treleaven, Columbian's technical manager for the East, Southeast, and South, theorized that improvement in traction was due to the fact that tires made with low structure blacks are softer than standard tires and therefore have a higher coefficient of friction.

Neotex blacks, like Cabot Corp.'s Regal blacks, were originally developed to provide tires with a softer, non-squeal ride. Columbian's study of skid resistance was made more or less accidentally after Treleaven was caught in a snowstorm without snow tires and found that his Neotex black tires gave him good traction.

The tests in Canada, conducted under Treleaven's supervision, were broken down into three types: tests on glare ice on a level stretch of Lake Bernard; tests on packed snow with an ice base on the level; and tests on two hills, both with packed snow on an ice base. One hill had an eight-degree grade, and the other an average 15-degree grade, ranging from 12 degrees at the bottom to 18 degrees near the crest.

Two types of tires were compared, a standard tread tire using Neotex 130 as against a standard tread using an ISAF masterbatch, and a snow tire using Neotex 100 against a standard snow tire using an HAF black. All tires were made by a major tire company under factory conditions, Treleaven said.

According to standard practice, the snow tires were used only on the two rear wheels of the cars; whereas the standard tread tires were used on all four wheels.

In the first test, on the glare ice of Lake Bernard, a governor was placed on each test car to get uniform top speeds, and each car was run from a standing start with the accelerator pressed to the floorboards. Flags were placed 20 yards from the starting line and 120 yards from the line. Checkers noted the time taken to cover the distance to both the first and second flags and also the speed of the car as it passed the 120-yard flag.

Each car was driven by two or three drivers running six to nine tests each.

The standard tire using Neotex 130 took 6.0 and 6.9 seconds to reach the 20-yard marker from a standing start, and 17.6 and 20.2 seconds to reach the 120-yard flag. The car was going 22 miles an hour when it hit the 120-yard flag. The snow tire covered the same distances in 5.5 and 16.9 seconds.

These figures were 20% better than for either the standard tires using ISAF blacks and 3% better than for the snow tires, Treleaven said.

Running the cars through the same tests in hard packed snow on the level, the tires using Neotex blacks had a 16 to 24% improvement over tires using standard blacks, he declared.

In the testing of the tires in skids, by running them at high speeds and then slamming on the emergency brake to lock the rear wheels, the Neotex tires showed 16% improvement when comparing the snow tires, and 24% when comparing the standard tires.

On the eight-degree hill, the tires were tested by pressing the accelerator to the floorboard from a standing start at the foot of the hill, then from a start at a speed of two miles an hour, pressing the accelerator all the way down when the foot of the hill was reached. In each case the Neotex black tires negotiated the hill, and the other tires did not, Treleaven said. Finally, by getting up a speed of eight miles an hour before reaching the foot of the hill, the standard tires made it, he added. The Neotex tires made the hill without difficulty, he also stated.

On the steeper hills, 12 to 18 degrees, the standard tires could not get traction he said. Instead, they slipped backward down the hill. The cars using the tires with Neotex black were stopped halfway up the hill and started again, stopped again two-thirds of the way up and restarted, and stopped and restarted three-quarters of the way up the hill. They did not lose traction.

The same test was run with Neotex black tires on a 30-degree hill, and the car was stopped and restarted, maintaining traction up the hill, Treleaven said.

Columbian indicated that the tests showed that tires using Neotex blacks would be useful as all-weather winter tires. Other tests are being made on wet roads to see whether the same difference in skid resistance is shown as for snowy and icy roads, Treleaven added.

Borden, U.S. Rubber Form Monochem, Inc.

The Borden Co. and United States Rubber Co., both of New York, N. Y., have organized Monochem, Inc., a jointly owned company, which will build a chemical complex in the Baton Rouge, La., area to convert hydrocarbons into more than a dozen chemical products.

Construction of a plant to produce acetylene and vinyl chloride monomer will be started soon on an 850-acre site in Geismar, La. Expected to be completed by late 1962, it will cost more than $20 million.

Present plans call for both companies to erect adjacent individually owned plants which will use the output of the Monochem plant for the manufacture of other chemical products. Total cost of the complex will be more than $50 million.

Akron U To Give Elastomer Course

The Institute of Rubber Research of the University of Akron offers a special intensive course on the chemistry and physics of elastomers from June 12-16, for a small group of scientists and engineers employed in industry and business.

The course, which will be limited to 25 persons, will cost $150, covering all expenses of the course and bound copies of summaries of the lectures, but not meals and housing expenses.

For more information concerning the course write: The Summer Session of the University of Akron, Akron 4, O., or to Dr. Maurice Morton, Institute of Rubber Research, at the University.

Tire Cords Don't Tire, Research Lab Reports

Tire cord in a good quality tire will maintain its strength almost indefinitely, Fabric Research Laboratories, Inc., Dedham, Mass., reported March 17 after making a study sponsored by rayon tire cord manufacturers.

The firm reported that in tests under severe driving conditions, nylon retained 85% of its original strength and Tyrex rayon tire cord 82% of its original strength after 15,000 miles. At that point the tire treads were bald.

The report said that almost all the strength losses came in the first 3,000 miles. After that, there was only a slight loss in strength.

The tests were made on four cars loaded to place 1,172 pounds of weight on each car. The 6.70 x 15 standard tubeless tires were inflated to 18 pounds, compared with the manufacturer's recommended inflation of 18 pounds. Each car logged 1,000 miles a day at an average speed of 70 miles an hour. Studies were made at 1,000, 3,000, 9,000, and 15,000 miles. Two tires were removed at 8,000 miles because of tread separation. Cords used were 1650/2 denier Tyrex rayon, 840/2 denier nylon, and 1650/2 denier viscose of German manufacture with an isocyanate dip. The last lost 26% of its strength, most in the first 9,000 miles.

The report suggested that the high loss in early mileage may have been due to severe changes in curvature, causing considerable flex in the cord. As the tires wore, the changes in curvature on loading became less severe.

The test was made, Fabric Research Laboratories explained, because technical people in the tire and cord business had expressed interest in a test under severe conditions, arguing that the conditions of a test made a year ago with a New York taxi fleet were not severe enough.

In the New York test, 7.50 x 14 tubeless tires were used with different tire cords, including 1100/2 denier Tyrex cord, 1650/2 denier Tyrex cord, and 840/2 denier nylon cord. Tires were run for 100,000 miles, with recapping at 20,000-mile intervals.

The results were similar to those in the recent Nevada test. Both types of tire cord lost 10 to 15% of their strength, almost all of it in the first 20,000 miles.

In the four cases where tires failed, two nylon cord tires and two rayon cord, the failure was what testers called "catastrophic." They said apparently failure of the cord was due to loss of adhesion placing a severe sudden strain on the cord.

The study was made by W. G. Klein, senior research associate, M. M. Platt, associate director, and W. J. Hamburger, director, of Fabric Research Laboratories. The study was sponsored by American Viscose Corp., American Enka Corp., Buckeye Cellulose Corp., Courtaulds (Canada), Ltd., Industrial Cellulose Research, Ltd., Industrial Rayon Corp., North American Rayon Corp., and Rayonier, Inc.

Are you a typical rubber company executive? Take a look at this sketch of an executive in the rubber industry as drawn from a questionnaire, "Do You Watch Birds?", sent to a sampling of RUBBER WORLD subscribers.

The typical rubber company executive is a president, vice president, owner, or technologist between the ages of 35 and 55. He lives in the East North Central area (New York, Pennsylvania, Illinois, Michigan, Indiana, Ohio), in a city of more than 100,000 people. He earns between $10,000 and $20,000 a year; and he is a college graduate with a major in chemistry or chemical engineering.

The executive belongs to the local rubber groups and the Rubber Division, American Chemical Society, but attends the ACS meetings more often than the rubber group or ASTM (American Society for Testing Materials) meetings.

He relaxes by playing golf, with gardening and cards as his second and third choices.

He takes two to three weeks' vacation, mainly during July and August when most plants close down for inventory.

He personally develops ideas for new items for his company and specifies the materials to be used. He also influences the selection of compounding ingredients, processing and auxiliary equipment. He often thinks it necessary to adapt or redesign equipment to suit his firm's needs.

Do you know this man?

Erie Forge To Acquire Continental Rubber Co.

Erie Forge & Steel Co., Erie, Pa., has agreed to acquire Continental Rubber Co., also of Erie, through an exchange of stock. Terms of the purchase were not disclosed. Special stockholders' meetings of both companies will be held no later than May to vote on the acquisition, E. Richard Eve, financial vice president of Erie Forge, said.

Erie Forge employs about 1,200 at its Erie plant, where it makes crankshafts for the railroad industry, ship shafts for the U.S. Navy, rotors for electrical equipment manufacturers, and heavy forgings and castings for the steel industry.

Continental Rubber is a supplier of Erie Forge, providing rubber coverings for shafts. In addition, its 600-man plant produces molded and extruded rubber goods, wrapped hose and related products, with 40% of its output going to the automobile industry as rubber seals for windshields and rear windows.

Erie Forge will operate the rubber company as a subsidiary and said the acquisition is part of its "expansion and diversification program" and will raise its consolidated sales about 35%.

Pennsalt Chemicals Centralizes Services

Pennsalt Chemicals Corp., Philadelphia, has moved its sales technical service groups from Wyndmoor and Devon, all in Pa., to a new two-story, 31,000-square-foot customer service laboratory at King of Prussia, Pa. This is the first unit to be completed in the company's planned $6-million technical center.

The move centralizes all groups providing technical customer services for Isotron refrigerants and aerosol propellents; rubber chemicals; and proprietary materials for metalworking, laundry, and dry cleaning, food and dairy plants, and household products.

Dayco Sells Tire Division To Firestone in Cash Deal

The board of directors of Dayco Corp., Dayton, O., approved the sale of the company's tire division to the Firestone Tire & Rubber Co., Akron, O., March 28.

Although the price was not named, it was hinted at when A. L. Friedlander, chairman of the board and chief executive officer of Dayco, said that proceeds of the sale will be applied against existing indebtedness, reducing the company's annual interest charges on debt by about $1 million a year.

"This will enable the company to replace the tire division's volume with more profitable sales," Friedlander said.

The tire division has been losing money for some time, partly as a result of low tire prices which have squeezed most smaller tire companies.

Firestone indicated that it will increase production of tires at the Dayco plant in Dayton after taking over. With a production of about 20,000 tires a day, Dayco was twelfth largest tire manufacturer in the United States.

Speculation is that Firestone will sell a lower priced line of tires under the "Dayton" brand name and maintain the Firestone name for its first-line tires. Firestone, however, has not yet revealed its plans for marketing its output from the Dayco tire division.

Friedlander said the sale in no way affects Dayco's 10 other manufacturing plants, its other subsidiaries and divisions, or its foreign technical agreements.

He added that the sale does not affect Dayco's substantial holdings in Copolymer Rubber & Chemical Corp., Baton Rouge, La., a large manufacturer of synthetic rubber. Dayco was one of the principal founders of Copolymer.

The tire division represented about 30% of Dayco's total sales volume. The remaining divisions manufacture and distribute industrial and automotive V-belts and hose, latex and urethane foam products, printers' rollers and blankets, and textile machinery parts and supplies.

Dayco's subsidiaries, which manufacture and distribute plastic rods, sheets, and tubes; rigid, flexible, and solid urethanes; aircraft seats; and specialized hose for the petroleum and chemical industries, include Cadillac Plastics & Chemical Co., American Latex Products Corp., Hardman Tool & Engineering Co., and Metal Hose & Tubing Co.

Committee D-11 Assigns SBR Number

Committee D-11 on Rubber and Rubber-Like Materials of the American Society for Testing Materials, through Subcommittee 13 on Synthetic Elastomers, has assigned Number 1715 to an oil-masterbatch polymer, at the request of Goodyear Tire & Rubber Co., Akron, O.

DESCRIPTION OF TYPES OF STYRENE-BUTADIENE (SBR) ELASTOMERS, ASSIGNMENT OF NEW CODE NUMBERS—ASTM D-11 D 1419

Number as assigned	1715
Date assigned	3/1/61
Distinctive feature	Low water sorption
Type	1700
Nominal temp., °F.	43
Activator	FRA
Shortstop	ND
Antioxidant	NST
Catalyst	OHP
Emulsifier	FA
Nominal bound styrene, %	23.5
Conversion, %	60
Mooney viscosity, ML 1-4 (212° F.), polymer	45
Coagulation	GA
Oil type	Naphthenic
Phr.	50
Finishing	Special

NOTE: Abbreviation and symbols are defined as follows:
FA—fatty acid
FRA—free radical type, i.e., iron-pyrophosphate, peroxamine sulfoxylate
GA—glue acid
ND—non-discoloring
NST—non-staining
OHP—organic hydroperoxide

G. L. Cabot Celebrates Hundredth Birthday

Godfrey Lowell Cabot, founder of Cabot Corp., Boston, Mass., manufacturer of carbon blacks, celebrated his hundredth birthday on February 26.

On hand to congratulate him were more than 50 members of his family, some from as far away as London, and members of the Cabot Corp. board of directors.

Harding-Glidden, Inc.

Godfrey L. Cabot being congratulated on his hundredth birthday by Owen J. Brown, Jr., who is a vice president of Cabot Corp.

Mr. Cabot began the manufacture of carbon blacks in 1882 in Worthington, Pa., and guided his company for 71 years. The organization is now international, with operations throughout the United States and carbon black plants in Sarnia, Ont., Canada; Ellesmere Port, Cheshire, England; and Berre L'Etang, Bouches-du-Rhone, France; Ravenna, Italy; Campagna, Argentina; it also is co-owner of plants in Australia and The Netherlands.

The Cabot organization is also a producer of oil-field pumping equipment, portable drilling-well servicing equipment, crude oil, natural gas, gasoline, pine tar, and other chemicals.

IISRP Establishes Three Committees

The International Institute of Synthetic Rubber Producers, Inc., held its second meeting in New York, N. Y. during the week of February 20. Bancroft W. Henderson, managing director of the Institute, announced appointments to the Technical Committee and to the SBR Division and the Statistical Committee of the North American Section. The activities and projects to be undertaken by these several committees will be announced in more detail soon.

The Institute's Technical Committee will have as chairman F. W. Hannsgen, Shell Chemical Co., U.S.A., and as vice chairman, E. S. Pfau, General Tire & Rubber Co., U.S.A. Other members of this committee follow: Edward Carr, Firestone Synthetic Rubber & Latex Co., U.S.A.; Paul Cornell, Goodrich-Gulf Chemicals, Inc., U.S.A.; K. G. Burridge, International Synthetic Rubber Co., Ltd., England; Yorinori Yoshida, Japan Synthetic Rubber Co., Ltd., Japan; W. W. Crouch, Phillips Chemical Co., U.S.A.; D. E. McLellan, Polymer Corp., Ltd., Canada; J. Van der Bie, Shell International Co., Ltd., England; John H. McKenzie, United Carbon Co., U.S.A.; D. C. McCleary, United States Rubber Co., U.S.A.; T. W. Boyer, American Synthetic Rubber Corp., U.S.A.; C. Capitani, A. N. I. C., Italy; F. Engel, Chemische Werke Huls, Germany; R. Schultz, Copolymer Rubber & Chemical Corp., U.S.A.; and M. Wendt, Goodyear Tire & Rubber Co., U.S.A.

The SBR Division, North American Section, will have as chairman, I. W. Adams, Jr., Copolymer Rubber, and as vice chairman, C. A. Hill, Firestone Synthetic Rubber. Other members are as follows: F. J. Sackfield, American Synthetic Rubber; John A. Kleinhaus, General Tire; D. L. Matthews, Goodrich-Gulf Chemicals; M. J. Rhoad, Goodyear; C. M. Tucker, Phillips Chemical; E. E. Gale, Polymer Corp.; R. L. Kittle, Shell Chemical; A. G. Treadgold, United Carbon; and D. E. Welch, U. S. Rubber.

The Statistical Committee, North American Section, chairman will be D. A. MacDougall, Firestone Synthetic Rubber. Other members of this committee are: R. S. Faylor, Goodyear; L. Smith, U. S. Rubber; K. Greene, Goodrich-Gulf Chemicals; and C. R. Sykes, Polymer Corp.

Stereo Rubber Pact

Goodrich - Gulf Chemicals, Inc., Cleveland, O., has signed an agreement with Chemische Werke Huels Marl, West Germany, for exchange of technical information on *cis*-polyisoprene and *cis*-polybutadiene.

The companies will exchange data on laboratory and pilot-plant results, process design, plant design and manufacturing know-how, both for the purposes of improving knowledge on plant design and operation and to promote sales of the products. Huels now holds a license under Goodrich-Gulf's West German patent rights in the field and is also licensed under the patents of Prof. Karl Ziegler, who developed the Ziegler catalyst used in polymerization of stereo-specific rubbers.

Huels is one of the leaders in the field of synthetic rubber development in Europe and particularly has achieved considerable progress in the use of stereo-specific catalysts of the Ziegler type.

Revise Holland Cloth ASTM Specification?

Several requests have been made for revision of the specification covering Holland cloth which has been an ASTM Standard since 1935 and considered by many as obsolete (ASTM D 376-35, Specification and Methods of Test for Holland Cloth).

This Standard is under the jurisdiction of Committee D-13 on Textiles Materials, Subcommittee B-9 on Fabric Test Methods, General. The Subcommittee is very anxious to obtain comments and suggestions from the rubber industry in considering this test revision. Anyone interested is requested to contact Mr. H. H. Gillman, Bishop Mfg. Corp., 10 Canfield Rd., Cedar Grove, N. J.

obituaries

Harris & Ewing

Harry L. Fisher

Harry L. Fisher

Harry Linn Fisher, noted scientist and educator, international authority on natural and synthetic rubbers, 1954 national president of the American Chemical Society, and 1928 chairman of its Division of Rubber Chemistry, died suddenly after a brief illness on March 19, at his home in Claremont, Calif. He was 76 years old.

Dr. Fisher, a graduate of Williams College, received his Ph.D. from Columbia University in 1912 and then taught chemistry at Columbia and later at Cornell University until 1919. He was a research chemist for The B. F. Goodrich Co. and then for United States Rubber Co. before becoming director of organic chemical research for U. S. Industrial Chemicals. During World War II, Dr. Fisher was consultant to the Office of the Rubber Director and later special assistant to the director of the Office of Synthetic Rubber of the Reconstruction Finance Corp.

From 1953 to 1957, Dr. Fisher was professor of rubber technology at the University of Southern California School of Engineering and first director of the Tlargi Rubber Technology Foundation established by The Los Angeles Rubber Group, Inc., for teaching and research. Since his retirement from USC, he was vice president of Ocean Minerals, Inc., working on chemical methods to turn sea water into fresh water.

Dr. Fisher won the Modern Pioneer Award from the National Association of Manufacturers in 1940 for developing a method of attaching rubber to metal. He received the Charles Goodyear Medal from the Rubber Division, ACS, in 1949, and the Chandler Medal from Columbia University in 1954 for outstanding contributions to the chemistry of synthetic rubber. He was the author of more than 50 articles and patents and of several books, the most recent of which was the "Chemistry of Natural and Synthetic Rubbers," published in 1957. RUBBER WORLD was honored to have had Dr. Fisher as a member of its editorial advisory board from 1946 until 1951.

Burial services were from Forest Lawn Memorial Park.

Surviving are his wife, two daughters, a son, and a brother.

John D. Gaffen

John (Jack) D. Gaffen, rubber chemist and general manager of Cat's Paw Rubber Co., Baltimore, Md., died March 3 after a sudden heart attack. He was 52 years old.

Associated with Cat's Paw more than a quarter of a century, Gaffen began his employment at the company as a chemist and rapidly advanced to the post of chief chemist.

Educated at Harvard University on scholarship grants, he held memberships in the American Chemical Society, American Society for Testing Materials, Chemical Institute of Canada, American Association for the Advancement of Science, and the Rubber Groups of Washington and Philadelphia.

He is survived by five sisters.

Norman Leeds, Jr.

Norman Leeds, Jr., assistant general manager of Raybestos Division, Raybestos-Manhattan, Inc., Stratford, Conn., died suddenly on March 12 at the age of 59.

Leeds started with the Raybestos Division in 1926 and served successively as process engineer, service engineer, assistant sales manager, sales manager, factory manager, and since 1956 as assistant general manager. He was elected to the board of directors of Raybestos-Manhattan, Inc., in 1955.

The deceased is survived by his wife, a daughter, his mother, two brothers, a sister, and two grandchildren.

news briefs

UNITED STATES RUBBER CO., New York, N. Y., announces price increases of 5% on first-line passenger tires and 2.5% on highway-type truck tires. The increases apply to U. S. Royal rayon and nylon tires, both tubed and tubeless; mud and snow tires; and its all-butyl passenger tire, the Butylride.

GOODRICH-GULF CHEMICALS, INC., Cleveland, O., has granted a license to Shell Chemical Co., Ltd., London, England, for the manufacture, use, and sale of polybutadiene and polyisoprene rubbers.

ROGER WILLIAMS TECHNICAL & ECONOMIC SERVICES, INC., Princeton, N. J., has incorporated a wholly owned subsidiary, Roger Williams Technical & Economic Services, S.A., in Geneva, Switzerland.

SIERRA TALC CO., South Pasadena, Calif., has established an eastern sales headquarters at 605 Broad St., Newark, N. J.

E. I. DU PONT DE NEMOURS & CO., INC., Wilmington, Del., has announced the start-up of a new plant at its Belle, W. Va., site to make methylamines and their derivatives.

VULCANIZED RUBBER & PLASTICS CO., Morrisville, Pa., has reorganized its set-up so that all executive, general, and division sales offices, formerly located in New York, N. Y., will now be operated directly from Morrisville.

GOODYEAR TIRE & RUBBER CO., Akron, O., has designed a new stock car racing tire, which was tried out February 26 at the Daytona 500-mile race. Called the Stock Car Special, the tire has a wide tread surface which helps dissipate heat and makes the tire run cooler.

COMMERCIAL SOLVENTS CORP. New York, N. Y., has opened a new West Coast office at Agnew, Calif., site of the company's West Coast plant.

GENERAL ELECTRIC CO., silicone products department, Waterford, N. Y., has established a second sales office in Texas. Located in Houston at 4219 Richmond Ave., the office will be operated in conjunction with a warehouse at the same address.

NAUGATUCK CHEMICAL DIVISION, United States Rubber Co., Naugatuck, Conn., has reduced the price of Flexzone 3-C from \$2.00 to \$1.40 per pound.

INTERNATIONAL LATEX CORP., chemical division, Cincinnati, O., has appointed The Paul Wiemer Co. sales representative for the southern Ohio area.

A pneumatic de-icer system, an electrical propeller de-icing system, and a single-disk brake, developed for lightweight aircraft by B. F. Goodrich Aviation Products, Akron, O., were installed on Max Conrad's *Piper Aztec* for his round-the-world flight. The pneumatic de-icing system uses stored energy in the form of compressed air or other inert gases which are released by the pilot to activate de-icers on the wings and tail. The electrical propeller de-icing system eliminates the weight of alcohol, tanks, pumps, valves, and motors

POLYMER CORP., LTD., Sarnia, Ont., Canada, will start construction of a full-scale polybutadiene plant this summer. The plant, which can be adapted to production of other stereospecific rubbers such as polyisoprene, will have an output of 20,000 tons a year. A solution polymer pilot plant has been in operation in Sarnia since 1958.

THE GOODYEAR TIRE & RUBBER CO. will begin its \$2-million expansion program for its Lincoln, Neb., V-belt plant with the construction of a \$400,000 addition to the plant.

ARMSTRONG RUBBER CO., West Haven, Conn., B. F. GOODRICH TIRE CO., Akron, O., and Sears, Roebuck & Co., Chicago, Ill., will test their tires on the new nine-mile automotive test track near Pecos, Tex., operated by Automotive Proving Grounds, Inc.

E. I. DU PONT DE NEMOURS & CO., INC., Wilmington, Del., has reduced the price of dimethylacetamide. The new bulk price is 50¢ a pound, a 22½¢ reduction.

REEVES BROS., INC., and SHELL CHEMICAL CO., both of New York, N. Y., entered into an agreement to develop polypropylene for its application in the fiber field.

UNITED STATES RUBBER CO., New York, N. Y., was granted a patent on Insulair, waterproof footwear with a cellular plastic inner layer, which adds warmth without weight or bulk. The patent covers the method of making as well as the product.

PENNSALT CHEMICALS CORP., rubber service laboratory, Wayne, Pa., has changed its address to Pennsalt Chemicals Corp., technical service laboratories, 900 First Ave., King of Prussia, Pa.

GOODYEAR TIRE & RUBBER CO., Akron, O., will add a three-story wing to its research laboratory. The \$1.5 million addition will be ready for occupancy by the end of 1961.

news about people

R. H. Kellar

R. B. Clymer

Robert H. Kellar has been named technical manager—processing for B. F. Goodrich Industrial Products Co., Akron, O.

Victor D. Aftandilian has joined the organic and polymer research section of Cabot Corp., Boston, Mass., as a research chemist; **Robert G. Nuttle** is a chemist in the new product research department; **George G. March** has been appointed a group leader in charge of CAB-XL research for the company's Watertown, Mass., pilot plant; and **Francis Heckman** has been made a group leader in the electron microscopy laboratory of the carbon black research department.

R. E. Hatch has been named president of Polymer Corp. (SAF), Strasbourg, France, and **S. C. Kilbank** has been made general manager. Other appointments include: **A. R. Powell,** plant manager; **James H. Watt,** chief accountant; **J. R. Ardagh,** staff assistant to the general manager; **R. J. Adams,** administrative assistant to the president; and **Stanley P. Loos,** production superintendent.

G. F. Baumann advances from project leader to group leader of the analytical research and polymer characterization group of Mobay Chemical Co., Pittsburgh, Pa. **J. W. Britain, P. J. Baker,** and **H. L. Heiss** have been made research specialists.

J. William Houtz becomes sales representative for the east central district of General Electric Co., silicone products department, Waterford, N. Y. He will be headquartered in Cleveland, O.

Roy B. Clymer has been appointed sales manager for Precision Rubber Products Corp., Dayton, O.

R. B. Perkins has been appointed manager, sales technical service laboratory, of Amoco Chemicals Corp., Chicago, Ill.

Albert F. McKee was promoted to regional sales manager of the Western Hemisphere and Far East for The General Tire & Rubber Co., Akron, O. **Robert C. Deal** was made regional sales manager of Europe, Africa, and the Middle East; and **Louis K. McKeivier,** product manager, associated products division.

Edwin M. Ott has been made manager of marketing planning for Pennsalt Chemicals Corp., Philadelphia, Pa.

Count Carlo Faina, president of Montecatini, has been awarded Italy's E. Vanoni Award for Public Relations, given annually by the Institute of Public Relations of Milan to a public figure who has achieved particular merit in this field.

S. R. Shuart will devote full time to the development of the butyl tire program for Enjay Chemical Co., New York, N. Y. **W. P. FitzGerald** will replace him as technical service coordinator.

G. L. Hembree is now Midwest sales representative for Thiele Kaolin Co., and its affiliate, Burgess Pigment Co., Sandersville, Ga.

Rueckl Studio

G. L. Hembree

Charles Mayer Studios

K. L. Lauer

W. H. Ware

S. F. Oakes

Willard H. Ware, president and treasurer since 1941 of Hobbs Mfg. Co., Worcester, Mass., was made chairman of the board, still retaining his post as treasurer. **Stewart F. Oakes,** who joined the company in 1948 as assistant to the president, was elected president. **Preston W. Hall** will succeed Oakes as vice president.

G. H. Mearce, manager, special projects for the engineering and construction division of Polymer Corp., Ltd., Sarnia, Ont., Canada, is coordinating the design and construction of the synthetic rubber plant near Strasbourg, France, for Polymer Corp. (SAF). Other appointments include: **Frank H. Maltby** as construction project manager, and **J. W. McDonough** as assistant to the project manager.

Emmett F. Williams was appointed vice president and general manager of Goodyear Rubber Co., Middletown, Conn.

Norman E. Dotzenroth is now general purchasing agent for B. F. Goodrich Canada, Ltd., Kitchener, Ont., Canada.

Thomas H. Rodda becomes technical manager-belting for B. F. Goodrich Industrial Products Co., Akron, O. **Richard H. Green** has been named technical manager-hose.

Karl L. Lauer has been appointed technical sales representative for Harwick Standard Chemical Co., Akron, O., to contact the industry in western Pennsylvania, West Virginia, southern Ohio, and northwestern Ohio.

R. P. Simoncini E. W. Varnum

E. F. Coakley R. E. Pauley

Pach Bros., N.Y.

W. M. Young D. M. Smith

Walter M. Young has been elected a vice president of Richardson Scale Co., Clifton, N. J. He continues to direct the marketing activities of the company.

Byron C. Bailey has been appointed project engineer for United Carbon Co., Houston, Tex.

Henry Robbins joins American Biltrite Rubber Co., Chelsea, Mass., as plant manager of the new Ripley, Miss., plant.

E. M. Grinstead has become manager, customer service, for Seiberling Rubber Co. of Canada, Ltd., Toronto, Ont., Canada.

Bertram Sayer has been appointed to the newly created position of manager, technical sales service, for Polyvinyl Chemicals, Inc., Peabody, Mass.

Robert P. Simoncini becomes assistant sales manager, machine division, for Hobbs Mfg. Co., Worcester, Mass. **E. Clayton Van Stavern** was made sales engineer for the Northeast sales area.

Edward W. Varnum has been elected president of Quabaug Rubber Co., North Brookfield, Mass.; while **Francis C. Rooney** becomes chairman of the board, and **Herbert T. Mason,** former chairman and president, continues as treasurer.

Edward F. Coakley has been named sales representative, New England district, General Electric Co., silicone products department, Waterford, N.Y. His office will be in Boston, Mass.

R. E. Pauley has been made manager of national account sales, industrial products division, of Goodyear Tire & Rubber Co., Akron, O. **Frank R. Evans** becomes general manager, foam products division, with **George G. Kerr** succeeding him as general manager, shoe products division. **Charles B. Marks, Jr.,** administrator of marketing, new products department, takes Kerr's place as general sales manager, shoe products division.

Douglas M. Smith has been made marketing manager, mechanical goods division of United States Rubber Co., New York, N. Y.

Ralph H. McCollister becomes manager, project development division, of Enjay Chemical Co., New York, N. Y.

James M. Rice, Natural Rubber Bureau, Washington, D. C., was elected president of the Association of Asphalt Paving Technologists.

Eugene Taubel joins Claremont Pigment Dispersion Corp., Rosyln Heights, N. Y., as a member of its technical sales staff serving the New York and Connecticut area.

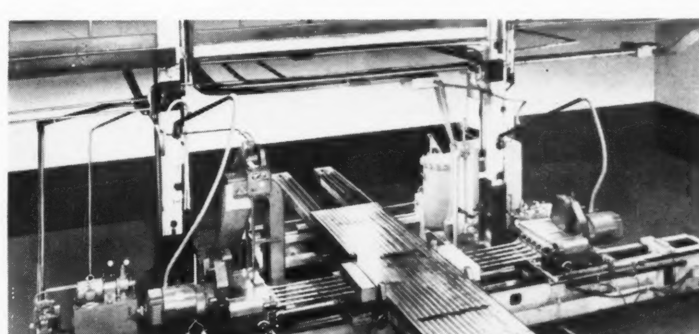
Henry E. Wessel has been made director of marketing, and **W. Paul Moeller** manager, international department, at AviSun Corp., Philadelphia, Pa.

Arthur L. Barney has been made research associate in the pioneering research laboratory at E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington, Del.

Richard G. Genton is now regional dust and fume engineer of Wheelabrator Corp., dust and fume control division, Mishawaka, Ind., and has been assigned to the southwest territory.

Harold J. Thoma has joined the sales department of Polyvinyl Chemicals, Inc., Peabody, Mass., as technical sales representative.

Willard F. Sheldon has been made an assistant director, sales service laboratory, of E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Chestnut Run, Del.



Adamson United Co., Akron, O., has developed an automatic deep-hole drilling machine for use in platen manufacturing, which makes accurately drilled channels for circulating platen heating and cooling mediums

news from abroad

Several Japanese Producers May Join Entry List for Stereo Rubbers Race

Two Japanese firms and one syndicate may join the race to produce stereo specific rubbers, one to produce polyisoprene, one polyisoprene and polybutadiene, and one ethylene/propylene rubber.

One, Bridgestone Tire Co., is definitely slated to produce both *cis*-1,4 polyisoprene and *cis*-1,4 polybutadiene on a pilot-plant scale in the near future. Production of polybutadiene is tentatively scheduled at 30 metric tons a month. The polybutadiene process is reportedly a new one, developed in collaboration with Professor Furukawa of Kyoto University.

Bridgestone is also expected to produce polypropylene and polyacetoaldehyde, the latter a synthetic resin produced from acetaldehyde reacted at 60-70° C. with a zinc diethyl catalyst.

The other prospective polyisoprene producer is Mitsubishi Kasei, which would supply the Japan Synthetic Rubber Co.

Maruzen Petroleum and four other Japanese companies are planning a petrochemical complex at Goi, Chiba prefecture, and have opened negotiations with Montecatini for production of isotactic butene and possibly ethylene/propylene rubber.

At press time Asahi Chemical Co. announced that it had concluded a licensing agreement with Firestone Tire & Rubber Co. to produce polybutadiene and polyisoprene. Provided government approval comes this summer, Asahi plans a $7.5 million plant, to go on stream in April, 1963. Initial plant capacity will be 10,000 tons a year of polybutadiene, followed by 10,000 tons a year of polyisoprene, beginning in October, 1964.

Another firm, Japanese Geon Co., is reportedly negotiating with B. F. Goodrich for techniques of manufacturing polybutadiene, and Ube Kosan Kaisha is reportedly negotiating a similar tieup.

Russia Also Active

Meanwhile other foreign producers have scheduled a total of about 500,000 tons of stereospecific rubbers by 1963.

The biggest producer prospectively is Russia, which, according to present plans, will produce 375,000 tons of polyisoprene and 30,000 tons of polybutadiene. According to the August issue of *Soviet Rubber Technology*, the new Soviet polyisoprene, SKI-3, has slightly higher tensile strength at 100° C. than Goodrich-Gulf's Ameripol SN or Firestone's Coral rubber, and about the same as natural rubber. The Russians report that carbon-black vulcanizates of SKI-3 have lower rebound resilience at 20 and 100° C. than either natural rubber or the standard Soviet polyisoprenes, owing to lower molecular weight of SKI-3 as compared with lithium catalyzed rubbers.

SKI-3 is produced with a modified complex catalyst, which Soviet researchers report gives better reproducibility than synthesis of *cis*-polyisoprene catalyzed with a triethyl-aluminum/titanium tetrachloride complex. Structure is similar to that of Ameripol SN, as are processing properties; while rate of cure of pure gum mixes and heat stability at 100° C. are about the same as for natural rubber. *Soviet Technology* reports that the better specimens contain 98-99% of *cis*-1,4 units, practically identical with natural rubber.

Interest Is World Wide

Other scheduled producers are Canada, the Polymer Corp., Ltd., plant to go on stream at the end of 1962 to have a capacity of 20,000 tons; Brazil, a Texas Butadiene and Cabot Corp. plant to be completed the end of this year, capacity 20,000 to 25,000 tons; Argentine, the Campo Duran chemical complex to be built by a syndicate headed by the Fish Corp., with a plant to produce 10,000 tons; England, a 10,000-ton plant of Shell-Imperial Chemical Industries, to be completed in 1963; and France, where the Societe des Elastomers de Synthese will complete SBR capacity this May, and probably get about 25,000 tons of stereo rubber production under way next year. All the plants are scheduled for production of either polyisoprene or polybutadiene, depending on market developments.

In addition, Farbenfabriken Bayer of Germany has pilot-plant production of polybutadiene, and Shell Nederland Chemische plans such production some time in the future. Montecatini of Italy is producing an undisclosed quantity of ethylene/propylene rubber.

The latest possibility is India, where Phillips Petroleum and Duncan Brothers of Calcutta have reportedly won government approval for a polyethylene and polyisoprene-polybutadiene rubber plant.

According to present figures, United States production of synthetic rubbers are expected to increase by about 250,000 tons between 1960 and 1965, almost all of the increase to be made up of stereo rubbers. On the other hand, the non-Communist countries are expected to increase all synthetic rubber production by nearly a million tons, only a little over 10% of that production in stereo rubbers. The Communist countries are also expected to increase their production by between a million and 1.2 million tons. The Russian total of 400,000 tons of stereo rubbers is the only stereo production announced behind the Iron Curtain, though news on Communist plans is always scant.

Italian-Soviet Trade

Italy and the Soviet Union have closed a trade agreement calling for Italy to export to Russia more than 12,000 tons of synthetic rubber, 4,000 tons of rayon and synthetic fiber, a million meters of synthetic textiles, and equipment for making tires, artificial fibers, acetylene, and ethylene.

Russia will send Italy four million tons of crude oil, including 2.7 million tons contracted for by ENI, the government oil agency, plus 700,000 tons of fuel oil and 40,000 tons of cellulose.

The mutual trade will amount to $120-$150 million, 20 to 50% over 1960 levels.

(Continued on page 111)


MORE GOOD NEWS ABOUT
SYNPOL
...IN COATING AND FLOORING
TEXUS

Used for a wide variety of coated fabrics, SYNPOL gives this sleeping bag softness and flexibility, protects against soil and moisture, insulates against cold weather.

Lightweight and capacious describes modern VAL-A-PAK® luggage of SYNPOL-backed nylon fabric for smart and lasting protection of clothing against dirt, dust and inclement weather. SYNPOL gives just the degree of flexibility required, provides a durable, non-staining interior surface to make this luggage so highly practical.

All coated fabrics described processed by **Aldan Rubber Co.**, Philadelphia.

The rugged, warm DUXBAK® hunting coat is lightweight, yet highly waterproof and windproof. A SYNPOL rubber resin lines and bloodproofs this jacket's expanding game pocket. SYNPOL guards against moisture, is permanently flexible.

TEXUS

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Consider the "good news" possibilities SYNPOL SBR Rubbers offer your product... present or proposed. Choose from the widest line of SBRs in the industry. Enjoy the product and processing advantages resulting from unusually rigorous quality controls. Discover the difference a SYNPOL can make.

Among the 30 SYNPOLS that can save you money and boost your product performance in these and other applications are:

SYNPOL	HOT TYPES			COLD	OIL-EXTENDED
	1001	1013	1061	1502	8200
DESCRIPTION					
Emulsifier	Fatty Acid	Fatty Acid	Fatty Acid	Mixed Acid	Fatty Acid
Stabilizer	Slightly Staining	Non-Staining Non-Discoloring	Non-Staining Non-Discoloring	Non-Staining Non-Discoloring	Non-Staining Non-Discoloring
Coagulant	Salt Acid	Alum	Salt Acid	Salt Acid	Glue Acid
Polymer					Polymer—100 pts.
Oil					NAPH—37.5 pts.
PROPERTIES					
CHEMICAL	Specifications	Specifications	Specifications	Specifications	Tentative Specifications
Volatile Matter % wt.	0.50 (Max.)	1.00 (Max.)	0.50 (Max.)	0.75 (Max.)	0.75 (Max.)
Ash % wt.	1.50 (Max.)	1.25 (Max.)	1.50 (Max.)	1.50 (Max.)	0.50 (Max.)
Organic Acid % wt.	4.00—6.25	4.00—6.00	4.00—6.50	4.75—7.00	3.90—5.70
Soap % wt.	0.75 (Max.)	0.01 (Max.)	0.75 (Max.)	0.50 (Max.)	0.50 (Max.)
Bound Styrene % wt.	22.5—24.5	42.0—44.0	22.5—24.5	22.5—24.5	22.5—24.5
Stabilizer % wt.	1.00—1.75	1.25 added	1.25 added	1.25 added	1.25 added†
PHYSICAL	Specifications	Specifications	Specifications	Specifications	Typical Production Values
Specific Gravity	0.935	0.965	0.935	0.935	0.925
Raw Viscosity, ML-4′—212° F.	44—52	40—50	44—52	46—58	56
Cpd. Viscosity, ML-4′—212° F.	73 (Max.)	73 (Max.)	73 (Max.)	73 (Max.)	52
Tensile psi 50′	2500 (Min.)	2500 (Min.)	2500 (Min.)	3100 (Min.)	3110
Elongation % 50′	500 (Min.)	600 (Min.)	500 (Min.)	575 (Min.)	740
Modulus psi 25′	325—625	350—750	325—625	350—650	390
Modulus psi 50′ 300% Elongation	750—1100	775—1175	750—1100	700—1150	650
Modulus psi 100′	1200—1600	1250—1750	1200—1600	1150—1650	920
Water Soluble Ash % wt.					0.35
Water Absorption mg./sq. cm.					0.78
TEST RECIPES[1]					
Polymer or Masterbatch	100.00	100.00	100.00	100.00	100.00
EPC Black	40.00	40.00	40.00	40.00	40.00
Zinc Oxide	5.00	5.00	5.00	5.00	5.00
Sulfur	2.00	2.00	2.00	2.00	1.75
Benzothiazyldisulfide	1.75	1.75	1.75	2.00	1.75
Stearic Acid		1.50			
REMARKS	General purpose hot rubber which is more resistant to staining and discoloring than 1000.	A high-styrene SBR, non-staining & non-discoloring, having reduced water soluble ash, low water absorption & excellent flow properties.	A non-staining non-discoloring polymer stabilized for maximum resistance to breakdown and gel formation during milling.	Non-discoloring and non-staining cold rubber. Higher physicals than 1006 and 1061.	An oil-extended polymer especially designed to give extremely high resistance to discoloration & staining. Low ash and low moisture absorption properties.
APPLICATIONS	Tires, molded and extruded mechanical goods, shoe soles & heels.	Calendered goods, closures, can sealants, adhesives and molded goods. Designed for applications requiring high green strength and excellent flow characteristics.	Light-colored & white products such as white sidewall tires, shoe soles, floor tile, toys, hospital sheeting, sporting goods, high-impact styrene.	Light-colored & white products such as white sidewalls, light mechanicals, floor tile, hospital sheeting, toys, soles, heels, food conveyor belts, high-impact styrene.	For use in light and bright colored products requiring outstanding sunlight resistance. Low ash content makes it particularly well suited for low-moisture absorption applications.

[1]The figures given are parts by weight of NBS Standard Compounding Ingredients. Press cure at 292° F.

†Based on non-extended polymer

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Houston 6, Texas
JAckson 3-3132

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Kuala Lumpur Conference Papers

The following summaries of papers given at the Natural Rubber Research Conference, Kuala Lumpur, Malaya, are printed for the interest of readers. A general review of the subject, plus summaries of papers by Professors G. E. Blackman and G. Gee, was printed in an earlier issue of RUBBER WORLD (November, 1960, page 125).

The Biogenesis of Rubber. Prof. J. Bonner, California Institute of Technology.

The stages are described by which the discovery, in 1949, that guayule and other rubber-bearing plants can form rubber from acetic acid molecules, finally led to isopentyl pyrophosphate, the actual unit that polymerizes to isoprenoids, including rubber. The main steps in the long process of building the 5-carbon isoprenoid from the 2-carbon acetate molecules were found to be: acetate molecules are converted to acetyl co-enzyme A and then built up to B-methyl-B-hydroxy glutaryl co-enzyme A, which contains six carbons derived from three acetate units. This is again converted to the 6-carbon mevalonic acid, which is a key compound in the sequence and which, upon phosphorylation, loses one carbon atom as carbon dioxide, giving the 5-carbon isopentyl pyrophosphate. The exact mechanism by which isopentyl pyrophosphate is polymerized to rubber in the tree is not known yet, but is under study.

Inhibition of Hardening in Natural Rubber. B. C. Sekhar, Rubber Research Institute, Malaya.

In an earlier work, the author ascribed the hardening of natural rubber sheet and crepe in storage, to the presence of aldehydic groups in the rubber molecule, a theory which finds support in the effect of diamines and formaldehyde treatment he now describes. Simple methods have been devised for estimating aldehyde groups and inhibiting their reaction so that it is now possible to produce rubbers which do not lose plasticity during storage.

Processing and Processability of Polyisoprene and Natural Rubber. R. H. Snyder, P. M. Nichols, D. E. Freiwald, and H. W. Hoerauf, United States Rubber Co.

Although similar to natural rubber in many respects, *cis*-polyisoprene differs markedly from it in certain raw properties. Major differences are:

(a) Tendency to looseness or bagginess on mill rolls under temperature conditions where natural rubber forms a tight band.

(b) Tendency to crumbling on mills, in Banbury mixers, or in the Mooney viscometer at elevated temperatures.

(c) Tendency to a characteristic surface scaliness when extruded.

(d) Markedly different flow properties.

Cis-polyisoprene is more like natural rubber than emulsion-type polyisoprene or SBR in regard to tack, but there is a greater tendency for joined raw surfaces to separate under a small continuous load than with natural rubber stocks. In most cases processing difficulties of polyisoprene can be overcome by suitable changes in equipment, techniques, or compounding. The unique flow characteristics are advantageous in many applications and preplasticization can be largely eliminated.

The laboratory tests to explain processing qualities of *cis*-polyisoprene should be of general use for other polymers.

Preparation and Application of Natural Rubber/Acrylamide Block Polymer. S. Kunisawa and Yuji Minoura, Japan.

A block copolymer with good oil resistance and excellent abrasion resistance was obtained by heating a mixture of natural rubber and acrylamide mixed on a cold open mill. The effect of mixing and heating conditions on the polymerization reaction was studied. Colored tires were experimentally made from the copolymer, and one of the tires was tested.

Methyl Methacrylate/Rubber Grafts of Predetermined Molecular Characteristics. B. C. Sekhar.

The effect of initiator concentration on side chain length of methyl methacrylate/rubber grafts is found to be significant only for monomer concentrations above 25%. An effective method to control molecular weight of side chains was developed, and the method and technological applications are discussed.

New Types of Superior Processing Rubber. B. C. Sekhar and P. S. Nielsen, RRI, Malaya.

The addition of small amounts of selected polymeric materials to filled and unfilled rubber is found to give processing characteristics superior to those of normal rubbers. The best physical properties are obtained by adding the polymeric material to latex before coagulation.

Manufacturing Advantages Obtained by the Use of SP Rubber. H. C. Baker and S. C. Stokes, Natural Rubber Producers' Research Association, Welwyn, England.

Used mainly in extrusion processes, SP rubber compounds extrude smoothly at higher viscosities, lower temperatures, and higher screw speeds; the latter two properties are particularly valuable with compounds liable to scorch. SP compounds have better shape retention and dimensional stability and during pan curing show reduced collapse and less watermarking than the usual rubber compounds. With calendered goods, they reportedly give easier stripping from the liner cloth, better surface finish, reduced shrinkage during cure of hand-built articles.

The usefulness and potential outlets of SP rubbers have been greatly increased by the development of PA 80, which can be blended with other rubber on open mills and internal mixers. When it is added to RSS in the ratio 1:3, a blend is obtained which behaves similarly to SP RSS. If necessary, the proportion of PA 80 can be raised to as much as 50%, with only slight reduction in the final physical properties.

Production of SP Rubber. G. W. Drake, RRI, Malaya.

The author outlines the development of SP rubbers and describes the chemical and physical tests and specification limits used to insure that no defective SP rubber is sold. Commercial progress is described, and diagrams give details of SP rubber production, the number of estates making SP rubber, and the destinations of shipments.

Properties of Low-Grade Rubber (Estate Brown Crepe). J. E. Morris and P. S. Nielsen, RRI, Malaya.

In 1949 a program was started to study the technical properties of all the various commercial grades of natural rubber. This paper deals with the raw rubber properties of samples of estate brown crepe collected from a number of estates in Malaya. Results of tests on the raw rubbers and pure gum compounds (ACS-1) are given, and the relation of properties to commercial grades is examined.

Observations on the Properties of Skim Rubbers. W. L. Resing, Cambodian Rubber Research Institute.

Serum obtained by centrifugation of latex was coagulated in several ways. Skim rubber obtained by fermentation until spontaneous coagulation occurs showed good overall properties, while calcium chloride coagulation had a bad effect on tensile strength and fatigue resistance under dynamic compression.

Application of Radiation in the Technology of Natural Rubber Latex. T. C. Gregson, T. H. Rogers, L. B. Bangs, and D. W. Peabody, Goodyear Tire & Rubber Co.

The effects were studied of high energy radiations on natural rubber latex (concentrated and preserved) using Cobalt 60 gamma rays, at doses from one to 20 megarads. Irradiation improved storage properties particularly of de-ammoniated latex. Foam rubber from irradiated latex had improved compression and shock properties, but ten-

sile strength and elongation decreased slightly; while volume shrinkage of molded foam stock increased. Extrusion flow properties of rubber from irradiated latex approached those of superior processing rubber. Irradiation of latex offers a practical means of improving properties for various commercial applications and can be carried out on a commercial scale with available electron accelerating machines or radioactive isotopes. A one-Mr. dose has been found economically more attractive than a higher dose. The possibility of using irradiation at the plantations is mentioned.

Clonal Influence on Latex Foam Properties. P. R. Gyss, CEC. Woo, and Chan Shee Peng, Socfin Co., Ltd., Malaya.

Investigations were conducted on the foaming behavior and properties of vulcanized foams prepared from latex collected from six different monoclone areas, at different seasons. Some samples included synthetic latex. Clonal origin, season, and especially the addition of synthetic latex all caused differences in results.

Studies on Gamma Irradiation of Natural Rubber Latex. M. Asao and Y. Minoura, Japan.

Water accelerates the vulcanization of natural rubber latex by gamma irradiation, but latices of various concentrations show no appreciable difference in crosslinking rate. The properties of the latex are not adversely affected; maximum tensile strength of the dried film is greater than that of solid rubber irradiated in air, and aging is quite good. The effect of organic halogen compounds was also studied.

Flocculation of Latex and Serum from Centrifugation: Development Prospects. M. Liponski and Vu Dinh Do, Vietnam Rubber Research Institute.

The addition of a colloidal hydroxide causes latex to flocculate, apparently as a result of deposition of the hydroxide on the protein layer. The best method is to precipitate the hydroxide in the latex; aluminum hydroxide gives the best results, then zinc hydroxide. As compared with coagulation, flocculation has the advantages that it is rapid, is readily mechanized, permits quick drying, and improves yield. Its disadvantages are that the flocculated raw rubber oxidizes more easily at high temperature, has greater scorch tendency, and contains 1% alumina. All other properties, especially aging of vulcanizates, are exactly like those of coagulated rubber. The method can be used to produce rubber powder and to flocculate skim rubber.

Progress in Masterbatch Technique. M. Liponski and Vu Dinh Do., Rubber Research Institute.

When a mixture of latex and a colloidal suspension of red clay (of basaltic origin from the rubber areas of Vietnam and Cambodia) is acidified, both colloids are destabilized at the same time. An intimate mixture is obtained which coagulates the more readily the higher the proportion of rubber and the smaller its particle size. Nitrogenous substances normally drawn off in the serum are carried to the masterbatch by the clay, with resulting increase in rate of cure. After processing, the coagulum dries quickly, and with suitable additives the dry material resists oxidation despite the presence of manganese in the red clay. Skim latex may also be used for such masterbatches, and greater amounts of clay can be incorporated, giving harder vulcanizates with no loss of tear strength, but with higher heat build-up than vulcanizates of fresh latex with the same filler content.

Manuring Rubber in Relation to Wind Damage. E. A. Rosenquist, Chemara Research Station, Seremban, Malaya.

Studies based on manurial trials and the relation of the findings to physiological variations in rubber trees suggest that high nitrogen and phosphate levels lead to weak wood by favoring protein formation and new growth at the expense of lignin and cellulose, and that deficiency of potash also makes for weak wood. To reduce susceptibility to wind damage, therefore, the manurial policy should be toward low nitrogen and high potash and probably toward low phosphate and high magnesium.

On the Contribution of IRCV Laboratories to Research on the Improvement of the Yield of *Hevea*. P. Compagnon, Vietnam and Cambodia Research Institutes.

Here mineral analysis is the basis of a system of diagnosis for correct manuring and is the main line of research toward improving yields. It reveals variations in metabolism and may help define indications of favorable metabolism. The relation of mineral composition and response to yield stimulation has been studied, as well as the part played in latex synthesis by mineral elements and organic compounds — carbohydrates, amino acids, and other organic acids; carbohydrates do not appear to be limiting factors. Investigations in microbiology suggest that enzymes may have some influence on yield.

Chromatography and Bio-Assay of Plant Growth Substances in *Hevea* Latex. S. G. Boatman, RRI, Malaya.

The principal hormone of many plant tissues, IAA (3-indolylacetic acid), has recently been shown to be capable of stimulating latex flow. No IAA has been found in *Hevea* latex, though a number of other unidentified growth substances, with unknown effect on latex flow, are present. Yet when IAA is applied as yield stimulant, the latex from tested trees contains large amounts of IAA as well as increased amounts of natural hormones. Work is continuing on the possible effect of these substances on latex yields.

Breeding for High Yield and Disease Resistance in *Hevea*. E. D. C. Baptiste, Rubber Research Institute, Ceylon.

The behavior is reported of clones produced in Ceylon by the backcross method of breeding, from high-yielding Eastern clones and imported Brazilian clones resistant to *Dothidella ulei*, the dreaded South American leaf blight. Examples are given of apparent breakdown of disease resistance, and the need is stressed of diversification of resistant material for use as genotypes. It is suggested that a station for *Dothidella* testing be set up, preferably in Turrialba, Costa Rica, with collaboration of an international body like FAO.

***Dothidella ulei* and the Selection and Breeding of *Hevea*.** Th. G. E. Hoedt, Pirelli Plantation, Belem, Para, Brazil.

The disease which has spread from the Amazon Valley to all adjacent rubber-growing countries in Latin America, recently made its appearance in the coastal rubber district of the state of Sao Paulo, Brazil, a thousand miles south of the Bahia rubber district, where it has been present for a long time. Methods of control and results of breeding high-yielding, resistant clones are discussed.

Acceleration of CR Studied by Russians

Accelerators are not generally used in making polychloroprene stocks in Russia, hence their interest in a study on how vulcanization was influenced by certain diamines, phenols, and other compounds—11 in all.[1]

The stocks were composed of polychloroprene — 100; magnesium oxide — 7; ZnO — 5 (all parts by weight), to which was added one part by weight of the test material. The vulcanizates were tested by standard methods except that the equilibrium modulus (number of crosslinks) was determined by a method described in the Russian literature.

All substances tested, except diazoamino benzene (DAB) increased equilibrium moduli and accelerated vulcanization. Pyrocatechol and m-phenylene diamine (PDA) were the most efficient, although both as well as p-PDA show particularly great reduction in tensile strength beyond optimum cure.

Particularly interesting because of their favorable effect on rate of cure

[1] *Soviet Rubber Tech.*, June, 1960, p. 19.

and mechanical properties, were monoethanolamine, ethylene diamine, and pyrogallol. All accelerators caused more or less marked scorch tendency except monoethanolamine and ethylene diamine. These two and triethanolamine were used in further tests on pure gum and carbon black stocks; ethylene diamine and triethanolamine gave the best results in both cases.

Unfilled stocks cure at a reasonable rate with one accelerator and no metal oxide, but properties are inferior to those of standard vulcanizates. Researchers found, however, that the amount of either oxide can be cut to one part by weight without greatly reducing tensile, while the stocks show good scorch resistance.

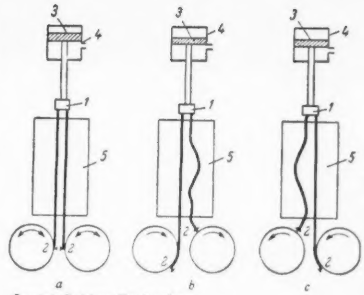
Although the incorporation of up to 80 parts of black to 100 of rubber reduces the activity of accelerators, tests at a mechanical rubber goods factory with lamp black stocks using triethanolamine showed that the curing cycle can be reduced 1.5 to two times under factory conditions and vulcanizates obtained with good tensile, elongation at break, and increased scorch resistance.

Russians Design Tire Cord Fatigue Tester

Tests on the fatigue life of viscose, cotton, and nylon tire cords under repeated elongation were made on a VDR-1 machine, giving results comparable with tire mileage.

The apparatus, designed by the Scientific Research Institute of the Tire Industry, operates as follows: two cords are held between upper (1) and lower (2) clamps (See illustration); the latter are fixed to two rollers which rotate around their axes, while the former (1) are connected to a piston (3) in a cylinder (4) under air pressure, which is set by a reducing valve according to the required load on the cord. The working length of the cord is in a thermostatically controlled chamber (5), with air temperatures up to 150° C. With both rollers simultaneously rotating clockwise (*b*), the right-hand thread is unloaded, and the left-hand loaded, from zero to maximum; with both rollers moving counter-clockwise (*c*), the right thread is loaded, and the left unloaded; thus each cord is alternately loaded and unloaded, the one being loaded when the other is unloaded. The resulting residual deformation is taken up by the action of the air pressure on the piston. A sinusoidal loading cycle is employed, with equal cord loading and unloading times.

The rollers turn through an angle of 12 degrees for polyamide and five degrees for cotton and viscose cords. To obtain comparable results on the



Soviet Rubber Technology

machine and in-service tests, the load on a cord is chosen from its elongation curve, taking into account its modulus under the deformation to which it is subjected in the tires.

Data on the effect of temperature and load on fatigue life of cord under repeated elongation were obtained. Photomicrographs (of Nylon 6 cord) show that failure of cord in tires is of a similar nature to that on the machine, also that failure of cord broken on a dynamometer is different from failure on the machine. In the latter case there is extensive breakdown of the fiber structure along its length under repeated stress, which is not observed in breaking on a dynamometer.

[1] *Soviet Rubber Tech.*, June, 1960, p. 25

Israel Chemical Plant

Israeli, Brazilian, and United States interests will build a petrochemical complex in Israel to produce 15,000 tons a year of ethylene and 6,000 tons each of polyethylene, carbon blacks, and detergent alkylate, it was reported. U. S. backers include Max Fischer, chairman of Aurora Gasoline Co., Detroit, and Sonneborn Associates Petroleum Corp. Negotiations for engineering are still in progress, but the plant is expected on stream late next year or early in 1963.

Polymer Gives Contract

Polymer Corp. (SAF), Strasbourg, France, newly formed subsidiary of Polymer Corp., Ltd., Sarnia, Ont., Canada, has awarded a $12-million contract for the design, engineering, and construction supervision of a 10,000-ton-per-year specialty rubber plant near Strasbourg, to Badger (France) S. à R. L., Paris, France. Badger N. V., Dutch associate company of Badger (France), will assist in handling the project. Both companies are affiliated with Badger Mfg. Co., Cambridge, Mass.

Strasbourg was chosen as the plant site because it is central for the common market countries; is in the midst of a heavy rubber consumption area; offers good transportation facilities; and will be near sources of raw materials.

Polypropylene Plant Planned for Japan

AviSun Corp., Philadelphia, Pa., has concluded an agreement with Shin Nippon Chisso Hiryo, K.K., Tokyo, Japan, to manufacture and sell polypropylene resin, film, and fiber in Japan. Construction of a 30-million-pound-a-year polypropylene plant, to be completed next year, is under way. The agreement has been approved by the Japanese Ministry of International Trade & Industry.

AviSun, an equally owned affiliate of American Viscose Corp. and Sun Oil Co., operates a 25-million-pound-a-year resin plant at Port Reading, N. J., and a 20-million-pound-a-year film unit at New Castle, Del. A 75-million-pound-a-year resin plant is also under construction at New Castle.

Swedish Firm Develops New Rubber Uses

Trelleborgs Gummifabriks A B, Trelleborg, Sweden, has developed several new uses for rubber in the building construction industry.

One of the most interesting methods worked out recently is that of applying a semi-fluid synthetic rubber compound to the joints between the wall units of prefabricated concrete houses. Before application with a spray gun, the compound, called Trebofog, is mixed with an accelerator intended to carry out the vulcanizing process. There are no solvents or volatile ingredients in the material which could cause evaporation, shrinkage, or drying.

A new method of making concrete sewer joints leak-proof has also been developed by the company in collaboration with another firm, Cementvarumaskiner, which evolved a system of precision-shaping the ends of the sewer units. Trelleborgs developed a type of rubber ring suitable for rolling into the joints, which had to be made according to very strict norms as to hardness, breaking point, aging, water absorption; so they would outlast the lifetime of the sewers.

Evaluation of Fillers

The effect was investigated of the fillers: talc, mica, latexyl (contains 91.8% silica, has average particle size between 15-25 micron), fiber glass, and whiting, on tensile, tear, and compression strength of latex foams; variations in mechanical characteristics, were determined before and after artificial and natural aging.[1]

[1] *Rev. gén. Caoutchouc*, Dec., 1960, p. 1677.

news from abroad

Best results were obtained by adding the fillers as dry powder while the latex foams up, except in the case of whiting, which must first be made into a dispersion. The proportion of filler that can be incorporated varies from 10% for whiting and mica and 20% for talc and fiber glass to 40% for latexyl.

Chopped fiber glass (4 mm.) was found greatly to improve mechanical properties, except elongation at break; the other fillers increase compression modulus, but reduce tensile and tear strength as well as elongation at break.

In aging tests, in Geer oven, and summer and winter weathering, filled foams aged better than unfilled foams, except in regard to elongation at break, and the more filler incorporated the better the foams aged.

Thermal degradation was found to be much more rapid than that produced by weathering.

The favorable effect of latexyl, fiber glass, and mica on tensile is distinctly greater than that of talc and whiting, the aging tests show, but all the fillers had approximately the same effect on the other mechanical properties, though latexyl and fiber glass have a slight edge over the others.

Mexico Ups Production

The value of Mexican rubber manufactures increased about 40 million pesos from 1958 to 1959, from 814,397,000 pesos to 854,405,000 pesos. The percentage of value represented by automobile tires and tubes increased from 74 to 74.6%. A total of 37,130 tons of natural and synthetic rubber, reclaim and scrap rubber was imported in 1959, compared with 34,456 tons in 1958.

The following table gives quantities and values (in 1,000 pesos) for chief products manufactured in the two years:

	1958		1959	
	Quantity	Value	Quantity	Value
Automobile tires	1,088,000	602,918	1,173,000	636,047
Bicycle tires	627,000	12,772	888,000	18,249
Automobile tubes	683,000	51,072	771,000	58,617
Bicycle tubes	212,000	1,819	261,000	2,345
Heels and soles (1,000 pairs)	43,413	116,239	66,332	118,872
Hose (meters)	553,109	8,641	952,483	9,199
Belts (piece)	65,555	10,986	143,822	11,616

THE TANGANYIKA GOVERNMENT is looking for investors in new rubber estates which it is hoping to establish in the Kilombero Valley. A government spokesman said no definite plans have been made, but argued that the area is suitable for production of high-quality tree rubber, with sufficient surface and underground water. Michelin is building a £2-million tire factory in Tanganyika.

Latex products will be manufactured at Caesarea, Israel, by Caesarea Polymer Corp., a subsidiary of Alliance Rubber & Tire Co., according to the Israel Government Investment Authority. Under a five-year contract, American Latex Corp., Hawthorne, Calif., a subsidiary of Dayton International, Dayton, O., will provide technical aid in exchange for 5% of the factory's net income from sales. The new plant will start producing foam rubber products and printing rollers for the domestic market.

SOCIETE LORRAINE - KUHLMANN, Dieuze, France, a subsidiary of Etablissements Kuhlmann, has added to its styrene materials an acrylonitrile butadiene styrene copolymer, which is being marketed under the name Lorkaril. The new product is claimed to have excellent impact resistance and rigidity at the same time; chemical resistance is good, and dielectric properties are outstanding. Moldings have a very shiny surface and require no polishing. Lorkaril comes in various qualities and can be processed with the usual equipment. It has a wide range of applications, from uses in the electrical radio, and automobile industries, to household wares, toys, and sanitary goods.

PELLETIZED NEWS

French tire and tube production in 1959 totaled 230,508 metric tons, compared with 224,878 metric tons the year before. In addition, 9,974 tons of tread rubber were produced, against 9,865 tons in 1958. Non-tire production in 1959 was 221,916 tons, contrasted with 210,760, and total rubber manufacture was 462,398 tons, against 445,503 tons in 1958.

Taxi drivers in Sydney, Australia, are switching to Japanese tires following refusal of local manufacturers to allow discounts, an official of the Metropolitan Taxi Council said. He said the Japanese tires cost £8/8s. for tubeless and £7/4s/6d. for tube tires compared with £10/6d. and £8/17s/-6d. for corresponding Australian brands. (Figures are in Australian pounds, with an exchange rate of $2.24 to the pound, compared with $2.79 for the British pound.)

MONTECATINI exhibited auto tires wholly or partly made of *cis*-1,4 polybutadiene at the European Plastics Exhibition held in Turin, Italy, September 22-October 2, 1960. Other Montecatini products displayed included moldings and extrusions of ethylene/propylene copolymer, oil-resistant components of Elaprim NBR rubber, and dashboards, steering wheels, and similar products of Aurtal, an ABS resin combining high impact resistance with good dimensional stability.

***Rubber and Plastics Weekly* is the new name** of the former *Rubber Journal and International Plastics* published by Maclaren House, London, England. The name change, according to the editors, was made because they felt it more correctly describes the function of the journal, and their responsibilities to these industries.

ERDOELCHEMIE GmbH, a company owned jointly by Farbenfabriken Bayer AG and BP Benzine und Petroleum AG, has started production of butadiene in West Germany. Its plant has a reported annual capacity of 30,000 tons.

French exports in 1959 included 52,415 tons of tires and 22,529 tons of rubber goods; while imports included 6,729 tons of tires and 6,757 tons of non-tire products.

SOCIETE DU CAOUTCHOUC BUTYL, French butyl producing group, is considering an increase to present capacity of 20,000 metric tons a year. Production of butyl last year was 17,515 tons, with 10,452 tons produced in the second half of the year, and more than 2,000 tons produced in December alone.

Replanting has left estates with large quantities of rubber wood unsuitable for building and usually burned. At the Forest Research Institute, at Kepong, it was found that pulp from this wood, blended with suitable pulps, can be used for making paper. A blend of pulps, it is noted, is used everywhere in the world in making paper, and bamboo or padi straw, in abundant supply in Malaya, would be suitable for blending with rubber wood, of which at present 5,000,000 tons are available annually.

PIRELLI, the Italian tire manufacturer, is reportedly building a tire factory near Istanbul, Turkey, with initial capacity of 120,000 tires and tubes a year. Eventually capacity is to be doubled, according to the report.

(*Continued on page 120*)

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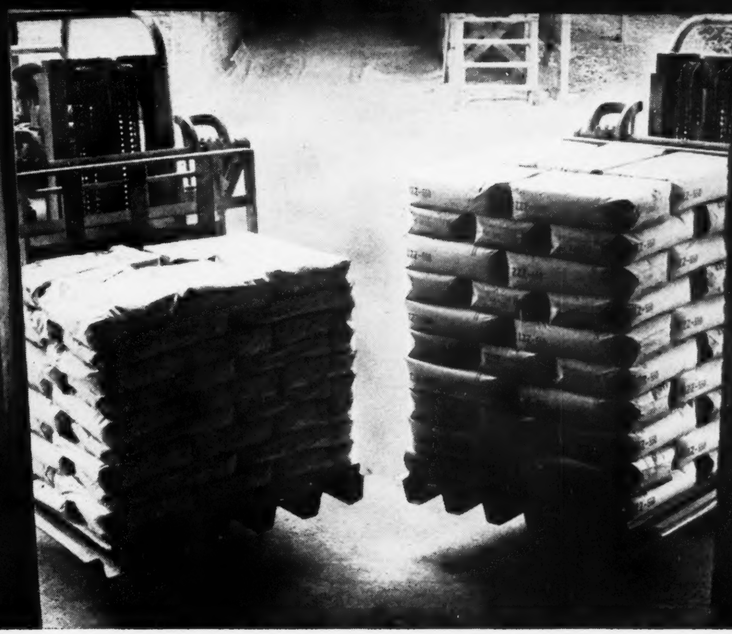

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market reviews

23¢ Tag on Oil-Extended Polyisoprene May Spur Lagging Interest in Polymer

Synthetic Rubber

Although most of the interest in stereo rubbers has been directed towards polybutadiene in recent months, the introduction by Shell Chemical Co. of Shell Isoprene Rubber 500, a polyisoprene extended with 25 parts of oil, may very well revive interest in polyisoprene.

The reason, of course, is the price tag of 23¢ a pound in carload quantities. Since polyisoprene is being pushed as a 100% substitute for natural rubber, with identical properties, tire manufacturers have shown little interest in the polymer unless it was available at lower prices than natural rubber.

Using the Natural Rubber Bureau's assumption that a tire might consist of 25% RSS #3, 25% RSS #4 Brown, and 5% Standard Flat Bark, at the present 30¢ for RSS #1, this would give you an average price of 25.64¢. (Current price is RSS #3, 29.75¢; RSS #4, 28.75¢; #3 Brown, 24.75¢, and Standard Flat Bark, 19.75¢.

At the 27¢ Shell price for polyisoprene, many fabricators saw no reason to make a switch from natural rubber for truck tires. However, the oil-extended polyisoprene might be competitive with natural rubber depending on its properties.

In addition, its present price might make it useful in passenger tires as a blend with SBR to give lower heat buildup while retaining the abrasion resistance and other good qualities of the SBR. In the past a blend of natural rubber and SBR was used for this reason.

The development also points the way for an oil-extended polybutadiene used as a blend with natural rubber, polyisoprene, or possibly SBR to give a high-quality passenger tire at competitive prices. With only between 25 and 30% of new rubber now going into truck tires, the field for polybutadiene is limited if it is confined to truck tires. Any development which would extend its use to passenger tires would be of major significance to rubber producers.

However, any development which would lead to use of polyisoprene or polybutadiene as part substitute for SBR will pose a major problem for rubber producers. Since most of the producers now going into production of stereo rubbers also produce SBR, they will by pushing use of the stereos be devouring their own young. There is already a substantial overcapacity of SBR production facilities, which will be aggravated by construction of facilities abroad. The increase in SBR facilities overseas in the next five years, not counting Iron Curtain countries, is estimated at a million tons a year.

There isn't much hope, however, that the producers can avoid competing with themselves, because they can't afford to let the opposition get the first jump. The only hope is that consumption of new rubber in the rest of the world will increase faster than presently estimated.

There was some good news for rubber producers in a 1½¢ reduction in the price of rubber-grade styrene. At the beginning of March, Koppers Co. cut prices of rubber-grade styrene from 12.59¢ a pound to 11¢, tank cars, f.o.b. works, freight equalized. Dow Chemical Co. indicated that it would go along with the move, and other producers of the monomer were expected to follow.

Koppers tied the styrene price to the price of benzene. As long as the price of benzene stays within the range of 31-34¢ a gallon, the price of styrene will stay at 11¢. Price of styrene will be adjusted upward or downward if the price of benzene goes above 34¢ or below 31¢.

At the same time Koppers cut the price of plastics-grade styrene from 14½¢ a pound to 13¢.

Drum prices for rubber-grade monomer are now 15¢ a pound carlots delivered and 17¢ less than carlots delivered. The same figures for plastics grade are 17 and 19¢.

The price cut was purportedly based on rising overcapacity and slowing demand from the rubber industry due to cutbacks in polymer production. In addition, there was talk that some of the 10 butadiene producers who do not have styrene plants, and the five SBR producers who have neither styrene nor butadiene facilities may be considering establishing styrene facilities. It is also considered possible that benzene producers, anticipating a possible oversupply of benzene in the near future, might go into styrene production.

Consumption of new rubber in the United States for January amounted to 122,351 long tons, compared with 111,967 long tons consumed during December, according to the monthly report of The Rubber Manufacturers Association, Inc.

Consumption of all types of synthetic rubber during January totaled 87,126 long tons, contrasted with 80,076 long tons in December. Synthetic rubber accounted for 71.21% of new rubber consumption, against 71.52% in December.

Natural rubber consumption for January was 35,225 long tons, compared with 31,891 long tons during December.

Production of synthetic rubber during January was 105,877 long tons, against 104,659 long tons in December. A total of 26,770 long tons of synthetic rubber was exported, compared with 23,231 long tons in December.

Consumption (in long tons) by type in January was: SBR, 72,220, compared with 67,549 in December; CR, 6,680, against 5,983 in December, IIR, 5,260, against 4,229 in December; and NBR, 2,540, compared with 2,315 in December.

The first figure for consumption of stereo rubbers, an incomplete figure for January, was 274 long tons. Other elastomers consumed in January totaled 152 long tons.

Production of black masterbatches for January was 2,657 long tons, compared with 5,493 in December; oil black masterbatch, 23,599 long tons, against 20,352 long tons in December, and oil masterbatch, 30,424, compared with 31,805 long tons in December.

Latex

The drum latex market remains moderate, with a fair amount of business for both near and forward positions. The bulk latex market continues very quiet, but steady.

Shipments from Malaya during January totaled 9,417 tons, contrasted with 7,428 tons during December. 2,411 tons were shipped to the United Kingdom, 1,659 to the United States, and 966 to Japan, compared with 1,479, 1,121, and 914 tons, respectively, in December.

Prices for ASTM centrifuged concentrated natural latex, in tank-car quantities f.o.b. tank car, were 34.06¢ per pound solids on March 15, against 33.23¢ on February 15. Synthetic latices prices remained at 26 to 40.24¢ for SBR, 37 to 57¢ for CR, and 45 to 60¢ for NBR.

(All figures in long tons, dry weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Nov.	0	3,456	4,338	9,284
Dec.	0	*	3,588	9,225
SBR				
Nov.	7,205	——	7,171	9,180
Dec.	6,934	——	6,756	9,204
Neoprene				
Nov.	1,169	0	914	1,798
Dec.	660	——	750	1,665
Nitrile				
Nov.	1,328	0	1,104	2,300
Dec.	996	——	898	2,242

* Not available yet for period covered.

Natural Rubber

If changes in market prices are a forecast of changes in business, then rubber demand should improve somewhat in the next few months.

The price of near rubber climbed nearly a cent during the February 16-March 15 period, from 29.20¢ a pound on February 15 to 30.10¢ a pound, March 15. The next day, beginning a new period, the price of near rubber jumped to 30.90¢.

The price of spot rubber rose even more, from 29.37¢ for RSS #1 on February 15 to 30.75¢ on March 15. While not spectacular, this rise was the first real one in rubber prices since the price slide started last July.

According to analysts, the price rise was spurred partly by increased demand by United States manufacturers, who seem to be purchasing for current needs.

For the rest, the market rise appeared to be the result of optimism. Part of this was caused by small increases in Russian and Chinese buying; the remainder apparently by the hunch that demand will increase in the next few months. Otherwise there seem few factors pointing to a strong price rise in the near future.

With prices above the 30¢ cutoff price, the General Services Administration is expected to start selling crude rubber from the federal stockpile again. Approximately 99,176 long tons have been sold since October 16, 1959.

As of February 15, trading began on a new Standard rubber contract, with the first delivery month May. The present Rex contract may not be traded beyond January, 1962, deliver. The new contract basis grade is No. 1 International Ribbed Smoked Sheets. Rubber inferior to No. 1 RSS is deliverable at discounts for half grade and lower than half grade, but not so low as No. 2 RSS.

February sales on the New York Commodity Exchange totaled 6,590 long tons, compared with 8,370 long tons for January. In addition, sales under the Standard contract for the last half of the month totaled 890 long tons.

There were 19 trading days in February and 19 in the February 16-March 15 period.

On the physical market, according to the Rubber Trade Association of New York, RSS #1 averaged 28.99¢ in February and 29.57¢ for the February 16-March 15 period, compared with 28.76¢ in January and 28.57¢ in the January 16-February 15 period. Average November seller's prices were RSS #3, 27.18¢; Amber Blankets, 24.13¢, and Flat Bark, 19.18¢.

REX CONTRACT

1961	Feb. 17	Feb. 24	Mar. 3	Mar. 10
Mar.	28.35	29.30	29.05	29.60
May	28.30	29.10	28.75	29.45
July	28.00	28.75	28.60	29.20
Sept.	27.90	28.60	28.30	29.05
Nov.	27.90	28.55	28.30	29.05
1962				
Jan.	27.80	28.45	28.30	29.05

STANDARD CONTRACT

1961	Feb. 17	Feb. 24	Mar. 3	Mar. 10
May	28.13	28.90	29.05	29.60
July	27.80	28.55	28.75	29.45
Sept.	27.70	28.40	28.60	29.20
Nov.	27.70	28.35	28.30	29.05
1962				
Jan.	27.60	28.25	28.30	29.05
Mar.	27.60	28.15	28.30	29.05

NEW YORK OUTSIDE MARKET

	Feb. 17	Feb. 24	Mar. 3	Mar. 10
RSS #1	28.85	29.25	29.13	30.00
#2	28.75	29.13	29.00	29.85
#3	28.63	29.00	28.85	29.75
Pale Crepe				
#1 Thick	31.13	31.25	31.37	32.00
Thin	31.13	31.25	31.37	32.00
#3 Amber Blankets	24.00	24.25	24.25	24.75
Thin Brown Crepe	24.00	24.25	24.25	24.50
Standard Flat Bark	19.25	19.13	19.25	19.75

Scrap Rubber

With virtually no reclaim business during the February 16-March 15 period, scrap rubber was at a standstill. Prices remained unchanged.

	Eastern Points Per Net Ton	Akron, O.
Mixed auto tires	$7.00/$11.00	$11.00
S.A.G. truck tires	nom.	nom.
Peeling, No. 1	nom.	25.00
2	nom.	nom.
3	nom.	nom.
	(¢ per Lb.)	
Auto tubes, mixed	4.00	4.00
Black	5.75	5.75
Red	nom.	nom.
Butyl	5.75	5.75

Reclaimed Rubber

Reclaimed rubber business continued at a very low level during the February 16-March 15 period because of depressed conditions in the auto industry. During the period one reclaim plant was closed down for a week for inventory adjustment.

Any improvements in business depend on better auto production. Business is expected to improve with spring buying, but no sharp upswing is expected until summer.

Reclaimed rubber consumption in January was 22,650 long tons, compared with 19,921 long tons in December. Production was up from 20,010 long tons in December to 22,150 long tons in January. Exports in January were 1,400 long tons, against 859 long tons in December.

RECLAIMED RUBBER PRICES

Whole tire, first line	$0.115
Third line	.1075
Inner tube, black	.17
Red	.22
Butyl	.16
Light carcass	.22
Mechanical, light-colored, medium gravity	.185
Black, medium gravity	.10

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims, in each general group separately featuring characteristic properties of quality, workability, and specific gravity, at special prices.

Rayon and Nylon

Last year for the first time more than half of all replacment truck tires sold in the United States were made with nylon cord, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., reported happily in March. More than 30% of original-equipment truck tires were nylon cord tires, Du Pont also said.

These figures compare with 15% of replacement and 5% of original-equipment truck tires in 1957, 33% replacement truck tires in 1957, and 47% of replacement tires in 1959.

The swing to nylon tires by truckers was no surprise. More interesting was the Bureau of the Census figures for

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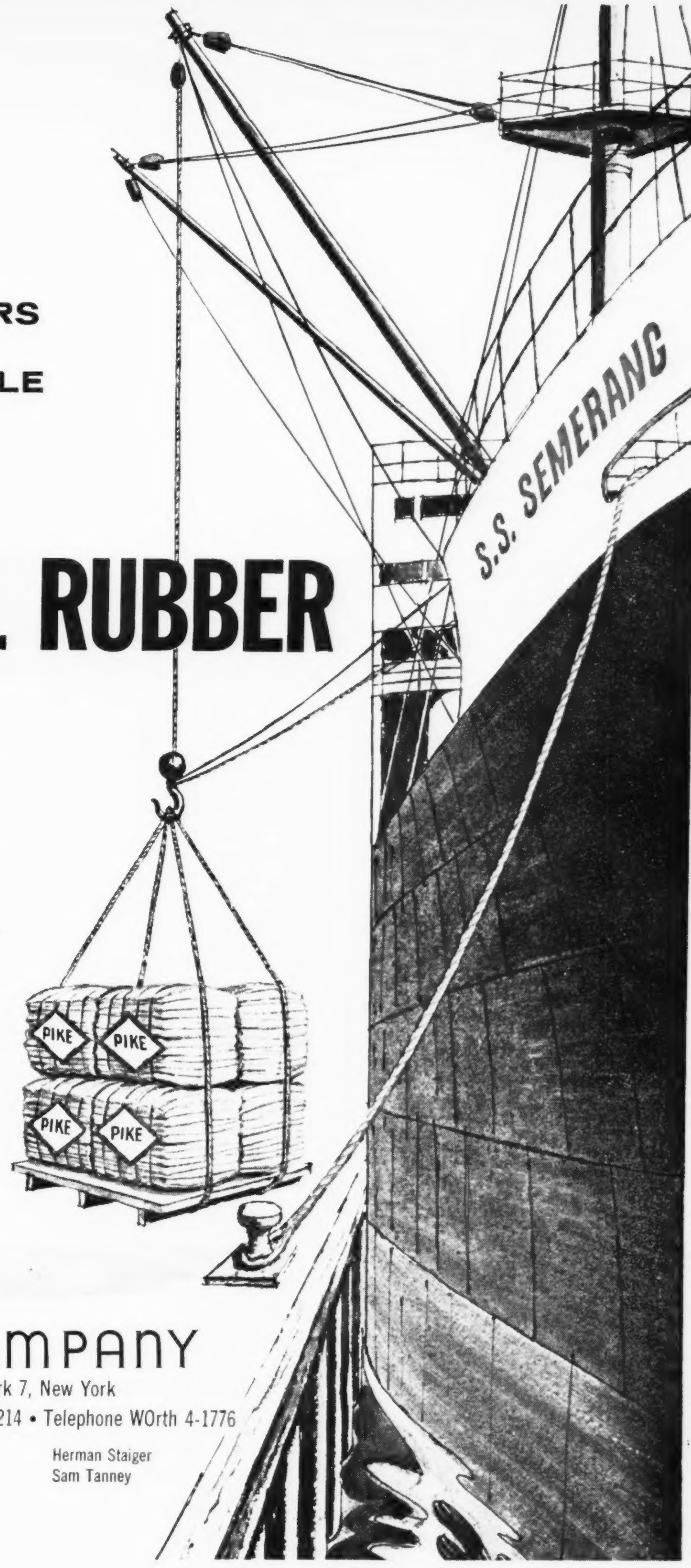

Importing Natural Rubber is about 95% of our total business. We make direct purchases in many foreign lands, including Ceylon, Malaya, Sumatra, Java, Borneo, Cambodia, Vietnam, Burma, Bolivia, Brazil, Nigeria, Belgian Congo.

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market reviews

total tire cord production in 1960. The figures showed that although rayon's poundage figures had remained high, going from 248.3 million pounds in 1958 to 296.9 million in 1959 and dropping to 239.6 million in 1960, its percentage of total production dropped from 71% in 1958 and 72% in 1959 to 63% in 1960. Nylon, meanwhile, was going from 29% in 1958 and 28% in 1959 to 37% in 1960. Poundage figures for nylon were (in millions) 95.6 in 1958, 124.1 in 1959, and 139.0 in 1960. (Actually the percentage figures exclude cotton, which dropped from 6.7 million pounds in 1958 to 3.0 million in 1960.)

The quarterly figures, however, are a bit more hopeful for rayon tire cord. Production dropped from 68.7 million pounds in the first quarter of 1960 to 64.7 million in the second quarter and 51.8 million in the third quarter, but made a comeback to 54.4 million pounds in the fourth quarter. Nylon production, on the other hand, rose from 36 million pounds to 41.2 million, then dropped to 32.9 million in the third quarter and 28.9 million in the fourth.

Packaged production of high-tenacity rayon yarn, according to *Textile Organon,* was 19.9 million pounds in February, contrasted with 28.8 million pounds in January. Domestic shipments declined from 22.3 million pounds to 18.3 million, and total shipments from 23.5 million to 20.5 million pounds. End-of-the-month stocks dropped from 18.7 million to 18.1 million pounds.

Rayon Prices

Tire Fabrics

1100/490/2	$0.69
1650/908/2	$0.58/.615

Tire Yarns

High-Tenacity	
1100/ 490	.51
1100/ 980	.51
1150/ 490, 980	.51
1230/ 490	.51
1650/ 980	.57
1875/ 980	.57
2200/ 980	.57
Super-High Tenacity	
1650/ 720	.57

Nylon Prices

Tire Yarns

840/140	.92
1680/280	.92

■

Pelletized News

(*Continued from page 114*)

The superior quality of rubber seed developed in Malaya is widely recognized, and in 1960 they had been in particularly great demand by various countries planning to expand and improve their rubber plantings. The best customers, Burma, Sarawak, North Borneo, and India, together bought 11,083,195 seeds, valued at $1,519,164 (Straits). Malaya permits shipments of seeds and budwood to countries which contribute to the Malayan Rubber Fund Board (Singapore, North Borneo, Sarawak, Brunei, Nigeria, and Britain) and to those who have reciprocal agreements with the Federation (Burma, Ceylon, Ghana, India, Indonesia, Liberia, Pakistan, Papua, Philippines, Thailand, Uganda, and Vietnam).

THE FEDERATION OF RHODESIA AND NYASALAND plans to import rubber trees from West Africa to boost output at the country's only rubber plantation, at Nkata Bay in Nyasaland. The plantation, which imported its first trees from Ceylon 50 years ago, now has more than 75,000 trees producing 300 pounds of rubber a year per acre.

ECUADORIAN RUBBER CO., set up by The General Tire & Rubber Co., Akron, O., as the principal stockholder, and local investors, will soon start construction on a plant at Cuenca, Ecuador, to produce 40,000 tires a year initially and 100,000 eventually.

■

Designed for emergency vehicles, a new tire developed by B. F. Goodrich Tire Co., Akron, O., has a scientifically determined cord angle which prevents the high-speed shock waves that heat up and destroy ordinary tires. It runs 20 to 25% cooler than regular tires at high speeds, the company also claims

Dr. W. J. Wald, a Neville Senior Scientist, places a rubber sample in a plastometer in Neville's new rubber laboratories. Constant research is conducted in the use and application of coumarone-indene resins in rubber compounding.

Your plastometer will show you why Neville C-I® Resins are a superior aid in rubber processing

The unique degree of plasticity derived from the use of Neville Coumarone-Indene Resins in rubber brings many benefits to your processing. You'll obtain improved mold flow, better knitting and a thinner flash line. Mixing, milling, calendering, and tubing will be faster, smoother, and cures will be more uniform.

But processing aid is not the only advantage gained by using Neville C-I Resins. You'll find marked improvement of tensile strength and elongation in many high quality formulations. Moreover, these resins are economically priced and may be used effectively to lower pound volume cost in highly loaded stocks while retaining physicals. They are available in flaked and solid form and in a wide range of colors from ½ to 16 Neville. Softening points are from 10° C. to 155° C. Use the coupon below to write for further information.

Resins—Coumarone-Indene, Hydrocarbon (Thermoplastic and Heat Reactive), Hydroxy • **Oils**—Plasticizing, Neutral, Rubber Reclaiming, Shingle Stain • **Solvents**—Aromatic (Refined and Crude), Semi-Aromatic (Refined and Crude). • **Antioxidants**—Non-Staining Rubber • **High Purity Indene.**

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statistics of the rubber industry

U. S. Consumption of Natural And Synthetic Rubber*

(Long Tons)

Year	Natural	SBR	IIR	CR	NBR	Total
1960						
Jan.	46,354	78,891	6,093	7,361	2,788	141,487
Feb.	46,022	76,999	6,070	7,369	2,765	139,225
Mar.	47,205	81,065	6,324	7,693	2,645	144,932
Apr.	42,032	75,849	5,492	6,525	2,386	132,284
May	41,263	77,423	5,602	6,471	2,497	133,256
June	42,576	80,951	5,150	7,129	2,619	138,425
July	35,229	67,853	4,597	4,936	2,027	114,642
Aug.	37,528	73,761	4,880	7,200	2,737	125,836
Sept.	36,770	72,593	4,901	7,906	2,740	124,100
Oct.	37,033	74,606	4,552	6,920	2,706	125,817
Nov.	35,965	72,702	4,455	6,372	2,650	122,144
Dec.	31,891	67,549	4,229	5,983	2,315	111,967

* Including latex.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Imports and Production of Natural And Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	SBR	CR	NBR	Total Synthetic	Natural and Synthetic
1960						
Jan.	5,339	9,720	1,154	1,131	12,005	17,344
Feb.	5,812	9,862	1,085	1,098	12,045	17,857
Mar.	5,127	9,351	1,004	1,217	11,572	16,699
Apr.	4,935	9,408	1,137	917	11,462	16,397
May	5,380	8,162	1,250	1,009	10,421	15,801
June	3,335	7,541	965	973	9,479	12,814
July	3,483	6,481	953	983	8,417	11,900
Aug.	4,174	8,096	978	1,291	10,365	14,539
Sept.	2,541	9,397	1,119	1,299	11,815	14,356
Oct.	2,042	9,063	1,272	1,176	11,511	13,553
Nov.	3,456	7,205	1,169	1,328	9,702	13,158
Dec.	....	6,934	660	996	8,590	....

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Imports and Production of Natural and Synthetic Rubber*

(In Long Tons)

Year	Natural	SBR	IIR	CR	NBR	Natural and Synthetic
1960						
Jan.	34,795	106,853	8,171	11,958	3,760	170,876
Feb.	40,949	104,603	6,514	12,106	3,111	173,095
Mar.	38,580	109,440	7,605	11,305	3,583	170,513
Apr.	36,343	97,963	7,958	11,879	3,095	157,238
May	32,018	102,501	9,814	11,401	3,088	158,822
June	31,639	98,635	9,475	11,614	2,823	154,186
July	28,555	95,584	8,389	10,210	2,401	144,939
Aug.	39,596	98,541	9,804	10,120	3,170	161,231
Sept.	31,862	90,392	9,183	10,078	3,190	144,715
Oct.	26,908	87,857	8,711	11,219	3,204	137,899
Nov.	30,411	87,540	8,365	11,261	3,299	140,876
Dec.	....	86,242	3,951	11,291	3,175	....

* Including latex.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	SBR	CR	NBR	Total Synthetic	Natural and Synthetic
1960						
Jan.	5,493	8,094	999	1,117	10,210	15,701
Feb.	5,463	7,838	969	1,000	9,807	15,270
Mar.	4,847	8,104	1,076	927	10,107	14,954
Apr.	4,199	7,154	913	976	9,043	13,142
May	3,655	6,821	868	978	8,667	11,322
June	3,975	7,147	1,033	981	9,161	13,136
July	2,912	5,433	729	780	6,942	10,854
Aug.	3,897	7,857	1,057	1,078	9,992	13,889
Sept.	4,250	7,458	942	1,122	9,522	13,772
Oct.	4,283	7,371	971	1,118	9,460	13,743
Nov.	4,338	7,171	914	1,104	9,189	13,527
Dec.	3,588	6,756	750	898	8,404	11,992

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U. S. Exports of Synthetic Rubber*

(Long Tons)

Year	SBR	IIR	CR	NBR	Total
1960					
Jan.	21,967	2,396	4,185	527	29,075
Feb.	22,791	1,528	4,588	740	29,647
Mar.	27,081	1,803	4,874	532	34,290
Apr.	28,765	2,006	5,268	676	36,715
May	23,337	1,936	4,213	1,320	30,806
June	23,130	2,062	3,699	464	29,355
July	19,721	3,792	4,446	616	28,575
Aug.	22,753	3,494	3,519	501	30,267
Sept.	16,836	3,500	3,340	389	24,065
Oct.	15,439	2,922	3,913	629	22,903
Nov.	17,792	1,928	2,760	546	23,026

* Including latices.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

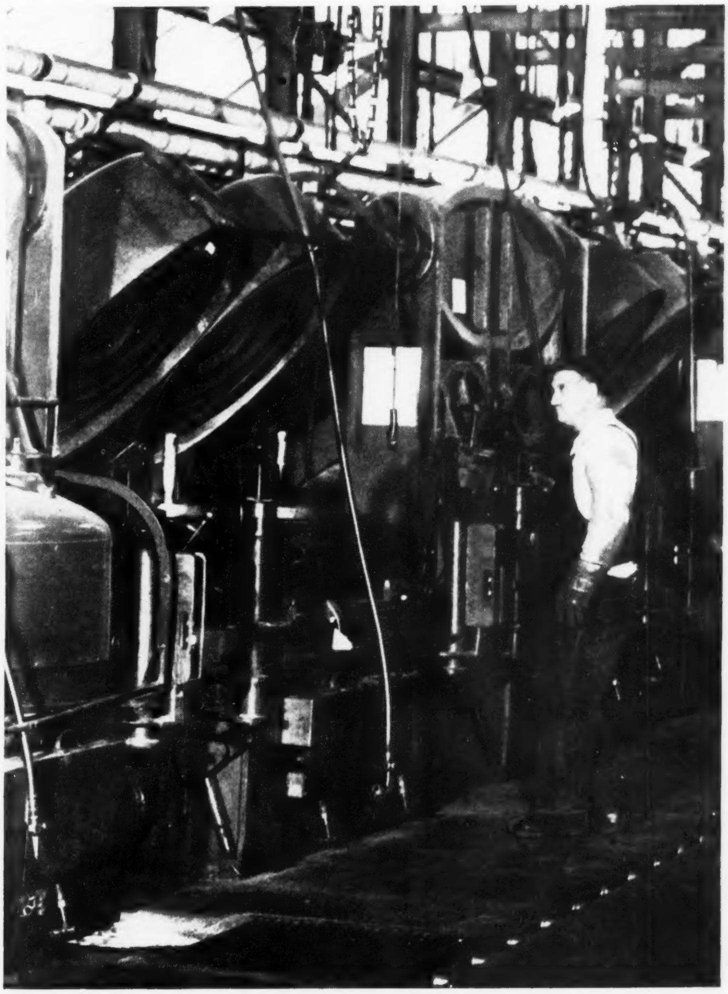
U. S. Reclaimed Rubber*

(Long Tons)

Year	Production	Consumption	Exports	Stocks
1960				
Jan.	26,442	26,540	1,106	29,031
Feb.	26,965	25,944	1,258	28,653
Mar.	29,100	26,625	1,542	29,719
Apr.	26,209	24,210	1,248	30,916
May	25,676	23,763	1,167	32,611
June	25,429	24,677	1,164	31,699
July	21,472	19,249	1,384	33,624
Aug.	23,540	21,452	951	33,979
Sept.	22,251	22,101	1,028	33,949
Oct.	23,546	23,269	804	33,519
Nov.	22,013	21,014	1,167	33,783
Dec.	20,010	19,921	....	33,048

* Natural and synthetic.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

Keep Production Moving



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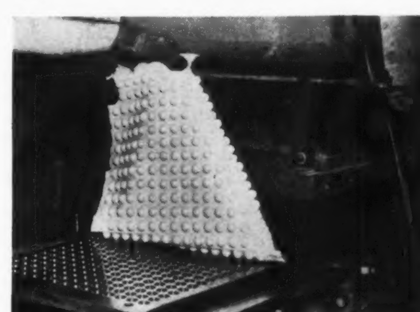

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World Production of Natural Rubber

(1,000 Long Tons)

Year	Malaya Estate	Malaya Native	Indonesia Estate	Indonesia Native	All Other	Total
1960						
Mar.	30.0	25.0	15.8	34.8	57.0	162.5
Apr.	28.1	18.8	14.7	40.4	53.0	155.0
May	33.0	23.8	16.7	32.3	54.2	160.0
June	34.3	24.0	16.7	31.8	54.6	160.0
July	37.1	26.0	17.9	27.9	46.1	155.0
Aug.	36.1	26.0	16.9	17.3	59.2	152.5
Sept.	36.6	25.1	16.2	36.9	56.7	172.5
Oct.	37.1	26.0	18.1	36.0	55.3	172.5
Nov.	35.6	21.6	18.7	17.0	57.1	150.0
Dec.	38.7	27.7	...	...	...	...

Source: Secretariat of the International Rubber Study Group.

World Consumption of Natural Rubber*

(1,000 Long Tons)

Year	U. S.	Eastern Europe and China†	U. K.	France	Germany	World Total†
1960						
Mar.	47.2	15.0	17.3	12.1	13.1	162.5
Apr.	42.0	26.9	13.5	11.0	11.0	160.0
May	41.3	24.9	14.3	11.2	11.9	160.0
June	42.6	35.9	16.4	11.2	10.8	175.0
July	35.2	29.8	11.2	10.3	10.8	155.0
Aug.	37.3	31.5	10.2	4.0	11.3	152.5
Sept.	36.8	30.1	16.7	11.5	11.8	165.0
Oct.	37.0	33.3	14.2	11.7	10.9	162.5
Nov.	36.0	...	13.8	...	11.5	162.5
Dec.	31.9	...	13.7	...	...	...

* Figures include latices.
† Estimated or partly estimated.
Source: Secretariat of the International Rubber Study Group.

World Production of Synthetic Rubber*

(1,000 Long Tons)

Year	U. S.	Canada	Germany	U. K.	Italy	Japan	Total
1960							
Mar.	131.9	14.2	7.3	7.7	5.5	..	165.0
Apr.	120.9	13.2	7.0	6.9	5.5	1.1	157.5
May	126.8	13.5	5.6	6.2	5.5	1.8	162.5
June	122.5	13.5	5.4	8.1	5.5	3.3	160.0
July	116.6	12.8	7.8	7.4	6.0	3.5	157.5
Aug.	121.6	12.7	7.2	7.9	6.0	2.1	160.0
Sept.	112.9	12.7	6.0	8.2	6.5	.8	150.0
Oct.	111.0	14.3	7.0	6.3	6.5	..	152.5
Nov.	110.5	13.4	7.8	7.9	6.5	..	150.0
Dec.	104.7	...	..	9.9	..	..	....

* Figures include latices. No data available from Iron Curtain countries.
Source: Secretariat of the International Rubber Study Group.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U. S.	Canada	U. K.	France	Germany	Japan	Total†
1960							
Mar.	97.7	5.4	10.5	8.1	9.0	4.6	155.0
Apr.	90.3	4.4	8.4	7.6	7.7	4.8	145.0
May	92.0	4.2	9.0	8.0	8.9	4.9	147.5
June	95.8	5.0	10.0	8.0	8.2	4.9	152.5
July	79.4	3.9	7.8	7.4	8.4	5.4	132.5
Aug.	88.6	3.8	7.0	3.2	9.1	5.4	142.5
Sept.	87.3	5.0	11.3	8.6	9.4	5.4	150.0
Oct.	88.8	4.5	9.6	8.7	9.3	..	152.5
Nov.	86.2	5.2	9.2	..	9.6	..	147.5
Dec.	80.0	..	9.3	..	..	..	....

* Including latices.
† Figures estimated. No account has been taken of synthetic rubber originating in Eastern Europe.
Source: Secretariat of the International Rubber Study Group.

U. S. Rubber Industry Employment Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumer's Price Index
All Rubber Products					
1939	121.0	$27.84	39.9	$0.75	
1960					
Apr.	200.7	94.60	38.3	2.47	126.2
May	197.6	100.04	39.7	2.52	126.3
June	197.9	102.72	40.6	2.53	126.5
July	191.7	103.53	40.6	2.55	126.6
Aug.	197.0	100.15	39.9	2.51	126.6
Sept.	197.8	98.28	39.0	2.52	126.8
Oct.	197.9	101.49	39.8	2.55	127.3
Nov.	194.1	100.58	39.6	2.54	127.4
Dec.	189.7	....	...	...	127.5
Tires and Tubes					
1939	54.2	$33.36	35.0	$0.96	
1960					
Apr.	78.1	107.38	36.9	2.91	
May	77.0	117.51	39.7	2.96	
June	76.6	121.39	40.6	2.99	
July	75.9	123.71	41.1	3.01	
Aug.	75.7	115.25	39.0	2.94	
Sept.	74.5	112.40	38.1	2.95	
Oct.	73.8	117.00	39.0	3.00	
Nov.	72.6	117.00	39.0	3.00	
Rubber Footwear					
1939	14.8	$22.80	37.5	$0.61	
1960					
Apr.	18.5	77.01	38.7	1.99	
May	18.1	81.40	40.1	2.03	
June	18.2	82.82	40.6	2.04	
July	17.6	82.21	40.3	2.04	
Aug.	18.2	81.20	40.1	2.02	
Sept.	18.5	79.18	39.2	2.02	
Oct.	18.5	82.59	39.9	2.07	
Nov.	18.6	81.77	39.5	2.70	

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
Other Rubber Products				
1939	51.9	$23.34	38.9	$0.61
1960				
Apr.	104.1	88.43	39.3	2.25
May	102.5	90.12	39.7	2.27
June	103.1	92.34	40.5	2.28
July	98.2	91.66	40.2	2.28
Aug.	102.2	92.75	40.5	2.29
Sept.	104.8	92.10	39.7	2.32
Oct.	105.6	93.73	40.4	2.32
Nov.	102.9	92.00	40.0	2.30

Source: BLS, United States Department of Labor.

U. S. Rubber Use by Products

(1,000 Long Tons)

Year	Transportation Natural	Transportation Synthetic	Transportation Total	Non-Transportation Natural	Non-Transportation Synthetic	Non-Transportation Total	Grand Total
1959	354.7	669.6	1,024.3	200.4	401.7	602.1	1,627.7
1960							
1st qt.	94.8	176.1	270.9	44.8	110.0	154.7	425.7
2nd qt.	87.2	176.7	263.9	38.7	101.4	140.0	404.0
3rd qt.	73.7	160.4	234.0	35.6	95.0	130.5	364.5
4th qt.	67.9	157.9	225.7	37.0	97.2	134.2	359.9

Source: United States Department of Commerce, Business & Defense Services Administration.

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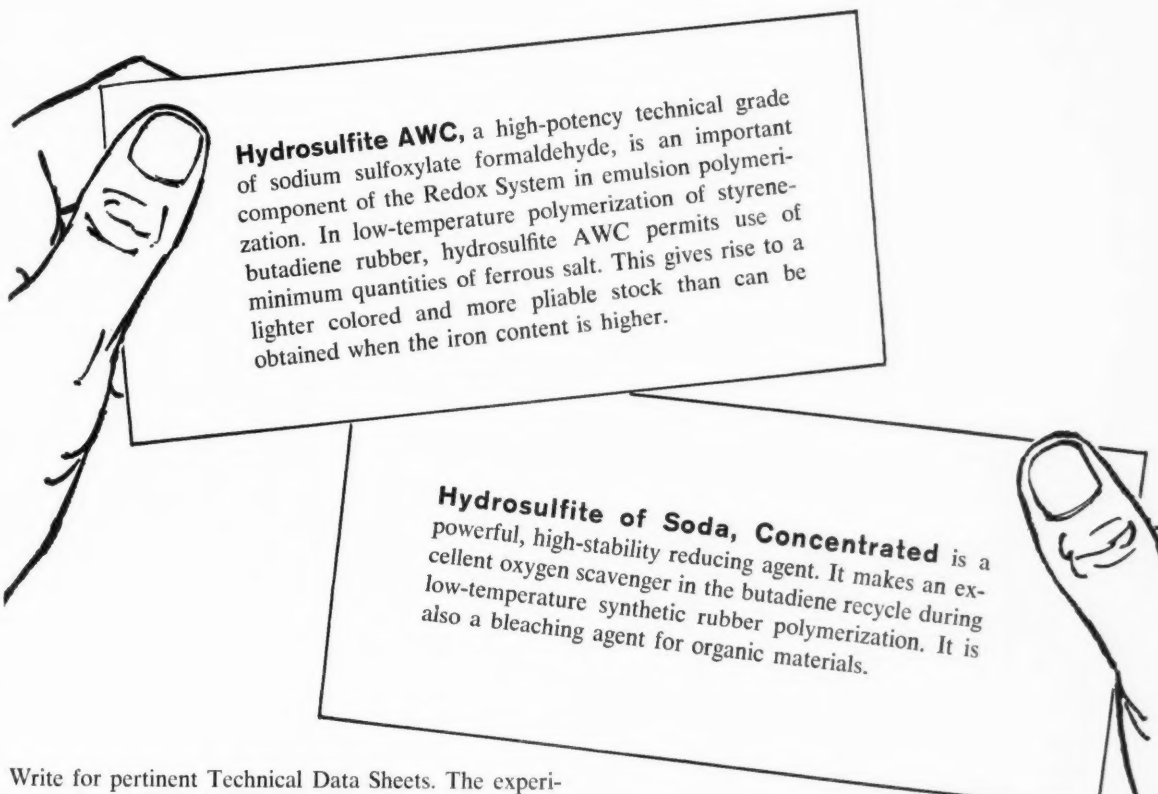

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Manufacturing Licensees Throughout the World

Carbon Black Statistics—January, 1961

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; GPF, general-purpose furnace black; FEF, fast-extruding black; HAF, high abrasion furnace black; SAF, super abrasion furnace black; ISAF, intermediate super abrasion furnace black.

(Thousands of Pounds)

	Jan.
Production	
Furnace types	
Thermal	12,195
SRF	24,487
HMF	2,774
GPF	11,847
FEF	17,025
HAF	45,286
SAF	218
ISAF	26,373
Total furnace	140,205
Contact types	24,056
Totals	164,261
Shipments	
Furnace types	
Thermal	12,294
SRF	21,902
HMF	4,381
GPF	11,882
FEF	17,829
HAF	38,837
SAF	1,498
ISAF	25,796
Total furnace	134,419
Contact types	22,640
Totals	157,059
Producers' Stocks, End of Period	
Furnace types	
Thermal	22,875
SRF	44,448
HMF	8,753
GPF	8,747
FEF	18,319
HAF	63,268
SAF	3,267
ISAF	35,017
Total furnace	204,694
Contact types	73,542
Totals	278,236
Exports	
Furnace types	
Total furnace	......
Contact types	.....
Totals	.....

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

U. S. Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1959	3,624	41,522	890	46,036	46,059	10,536
1960	3,320	36,511	1,120	40,982	40,851	11,034
Aug.	169	3,056	83	3,308	3,017	10,254
Sept.	232	2,563	100	2,894	3,024	10,446
Oct.	222	2,666	111	3,000	3,067	10,589
Nov.	229	2,354	74	2,657	2,921	10,859
Dec.	224	2,498	95	2,817	2,913	11,034
1961						
Jan.	237	4,783	56	5,076	3,208	9,394

Source: The Rubber Manufacturers Association, Inc.

U. S. Automotive Pneumatic Casings

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
			Passenger Car			
1959	29,768	66,834	788.3	97,388	102,681	23,599
1960	36,321	65,222	895	95,685	105,466	23,583
May	3,361	6,542	78	9,981	9,548	22,985
June	3,098	7,099	94	10,290	9,544	22,271
July	2,456	6,377	82	8,915	8,680	22,097
Aug.	1,359	6,389	76	7,824	8,061	22,326
Sept.	2,676	5,749	59	8,484	8,158	22,037
Oct.	3,342	5,366	53	8,760	8,461	21,816
Nov.	3,171	4,123	55	7,348	7,979	22,493
Dec.	2,844	3,900	55	6,799	7,809	23,583
1961						
Jan.	2,191	5,955	44	8,189	8,234	23,691
			Truck and Bus			
1959	4,407	10,015	644	15,075	15,238	....
1960	3,686	9,249	728	13,875	14,463	3,797
May	363	764	80	1,207	1,321	3,982
June	352	785	80	1,216	1,319	4,087
July	279	851	68	1,197	1,109	4,011
Aug.	219	823	75	1,117	1,085	3,972
Sept.	273	811	61	1,146	1,026	3,856
Oct.	247	938	68	1,254	1,069	3,683
Nov.	255	649	51	955	1,066	3,797
Dec.	243	552	56	851	995	3,957
1961						
Jan.	258	635	48	941	988	3,991
			Total Automotive			
1959	3[illegible],183	76,848	1,433	112,465	117,918	26,955
1960	40,203	77,773	1,751	119,698	111,569	27,540
May	3,724	7,306	157	11,188	10,779	26,967
June	3,449	7,884	174	11,507	10,863	26,359
July	2,735	7,228	150	10,113	9,789	26,108
Aug.	1,578	7,213	151	8,941	9,147	26,298
Sept.	2,950	6,560	120	9,630	9,184	25,893
Oct.	3,589	6,304	121	10,014	9,530	25,499
Nov.	3,425	4,772	105	8,303	9,044	26,290
Dec.	3,087	4,452	112	7,650	8,804	27,540
1961						
Jan.	2,449	6,590	91	9,130	9,221	27,682

Source: The Rubber Manufacturers Association, Inc.

U. S. Rubber Industry Economic Indicators

Year	Production Index*: Total Rubber and Plastics Products, Seasonally Adjusted, % 1947-49	Seasonally Adjusted, % 1957	Without Seasonal Adjustment, % 1947-49	Without Seasonal Adjustment, % 1957	% Return†: On Sales R&MP‡	% Return†: On Investment R&MP
	100	100	100	100		
1960						
Apr.	201	115	201	118		
May	205	117	201	115		
June	214	122	208	119	3.9	8.4
July	204	117	177	101		
Aug.	201	115	191	109		
Sept.	194	111	196	112	3.3	6.8
Oct.	192	110	202	116		
Nov.	192	110	196	112		

* F.R.B. Index of Industrial Production revised to include plastics products and change base period.
† Base Data F.I.C.-S.E.C.-Quarterly Financial Reports—% Calculated by RMA.
‡ R&MP = Rubber and Miscellaneous Plastics, a classification revised according to the 1959 Standard Industrial Classifications.

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No. 14

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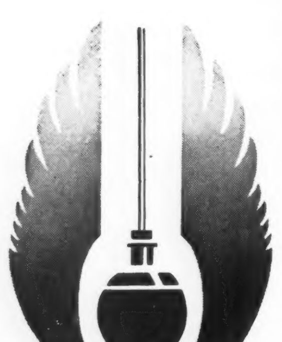
Specific Gravity @ 60/60° F.	0.938
Saybolt Universal Viscosity @ 100° F.	40 seconds
Flash Point, C.O.C.	180° F.
Weight per gallon in pounds	7.81
Color	Dark Brown

**P.S. Use "Maglite D" in your Neoprene batches and avoid scorching!*

HALLCO C-311 PLASTICIZES SYNTHETIC RUBBERS AND PLASTICS

This ester type plasticizer is a primary softener for nitro and ethyl cellulose, chlorinated rubber, polystyrene and various other synthetic rubbers. Hallco C-311 also functions as a secondary plasticizer for vinyl resins. Since it is of fatty nature, films containing it should be inhibited to prevent growth of mildew type fungi. When used as a wetting agent for colors and pigments it is helpful in formulation of special inks. Other uses of Hallco C-311 are found in the low temperature processing of Perbunam and Paracril type rubbers. In addition to producing rubber compounds that pass the ASTM Low Temperature Brittleness Test at minus 60° C, it also gives higher tensile strength and improved elongations. Hallco C-311 is also manufactured by The C. P. Hall Company and is available in drums or tank cars.

Samples and data on Hallco C-566 and Hallco C-311 are available on request. Order yours today!



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Plasticizer	Specific Gravity 25°/25°C ±.003	Viscosity 25°C, cps	Compatible With	Outstanding Characteristics
Dibenzyl Sebacate	1.055	21-22	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers.	Low Temp. Flexibility, Low Volatility, Permanence. Good Electricals
Dibutyl Sebacate	0.935	7.9	Vinyl Resins, Cellulose Acetobutyrate, Synthetic Rubbers, Rubber Hydrochloride, Polystyrene, Polymethyl Methacrylate.	Low Temp. Flexibility, Excellent Aging Qualities, Non-toxic
Dimethyl Sebacate	0.986*	3.54 @ 30°C	Vinyl Resins, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate, Acrylic Resins.	High Solvency and Efficiency, Wide Compatibility
Dioctyl Sebacate	0.913	17.4	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate.	Low Temp. Flexibility, Low Volatility, Good Electricals
Dicapryl Phthalate	0.972	55	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate.	Highly Compatible, Low Volatility, Excellent Viscosity and Stability
Diisodecyl Phthalate	0.965	65	Vinyl Chloride Polymers and Copolymers, Polyvinyl Acetals, Cellulose Nitrate, Cellulose Acetobutyrate, Chlorinated Rubbers.	Low Volatility, Good Electricals
Dioctyl Phthalate	0.983	57	Vinyl Chloride Polymers and Copolymers, Polyvinyl Acetals, Natural and Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate.	Highly Compatible, Good Flexibility
Isooctyldecyl Phthalate	0.973	68	Vinyl Chloride Polymers and Copolymers, Polyvinyl Acetals, Natural and Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate.	Improved Flexibility, Permanence, Good Electricals
Dioctyl Adipate	0.924	21	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Natural and Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate.	Low Temp. Flexibility
Butyl Stearate CP	0.857/0.86	9.1	Natural and Synthetic Rubbers, Cellulose Esters, Polystyrene, Polyvinyl Butyral: partly compatible with Polyvinyl Chloride and Nitro Cellulose.	Lubricity, Abrasion Resistance, Low Cost, Non-Toxic
Butyl Oleate, distilled	.8685/.869 @ 20/20°C	7.2	Most Natural and Synthetic Rubbers, Polystyrene, Cellulose Nitrate, Ethyl Cellulose.	Low Temperature Flexibility, Primary Plasticizer for Chloroprene, low cost
®Harflex 300	1.096	1400 @ 100°F/cs	Polyvinyl Acetate, Cellulose Acetobutyrate, Nitrocellulose, Ethylcellulose, Polymethyl Methacrylate.	Non-Migratory, Fast Processing Low Temp. Flexibility
®Harflex 325	1.100	2000 @ 100°F/cs	Vinyl Chloride Polymers and Copolymers, Polyvinyl Acetate, Synthetic Rubbers, Nitrocellulose, Cellulose, Acetobutyrate, Polymethyl Methacrylate.	Non-Migratory, Permanent
®Harflex 330	1.081	2270 @ 100°F/cs	Vinyl Chloride Polymers and Copolymers, Synthetic Rubbers, Nitrocellulose, Cellulose Acetobutyrate.	Non-Migratory, Permanence, Highly Compatible
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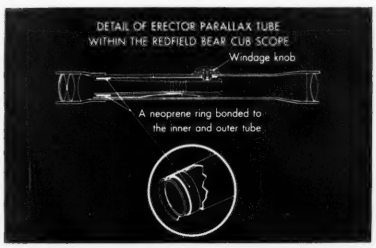

Eastman 910 Adhesive will form bonds with almost any kind of material...fast, too.

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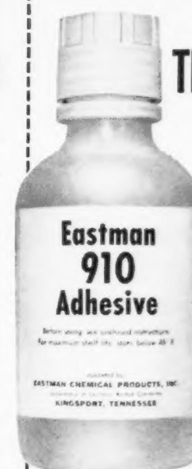
Here are the types of bonds that can be made with Eastman 910 Adhesive

Among the stronger: *Natural rubber, SBR, Buna N, most types of neoprene, steel, aluminum, brass, copper, most woods, vinyls, phenolics, cellulosics, polyesters, polyurethanes,* and *nylon.* Among the weaker: *polystyrene, polyethylene* and *fluoro-hydrocarbon plastics* (sheer strengths up to 150 lbs./in.^{2}).



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Sets fast—Makes firm bonds in seconds to minutes.
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High strength—Up to 5,000 lbs./in.^{2} depending on the materials being bonded.
Ready to use—No catalyst or mixing necessary.
Cures at room temperature—No heat required to initiate or accelerate setting.
Contact pressure sufficient.
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Goes far—One-pound package contains about 14,000 one-drop applications.
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See Sweet's 1961 Product Design File 10d/Ea.

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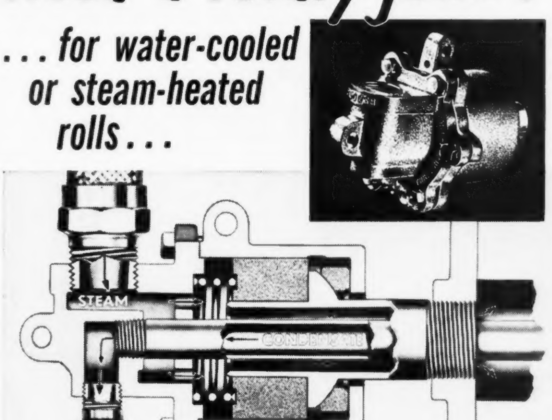

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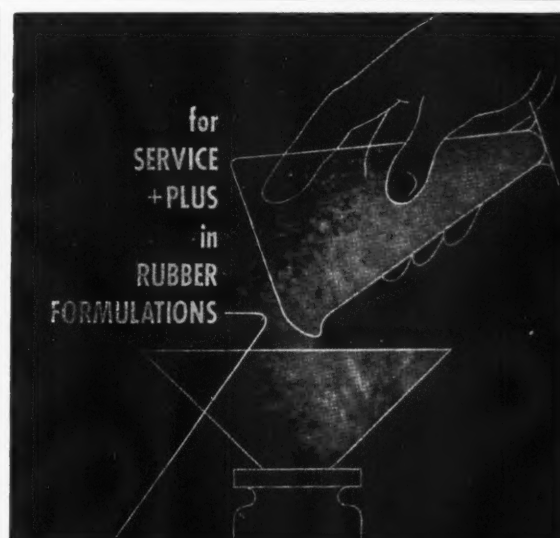

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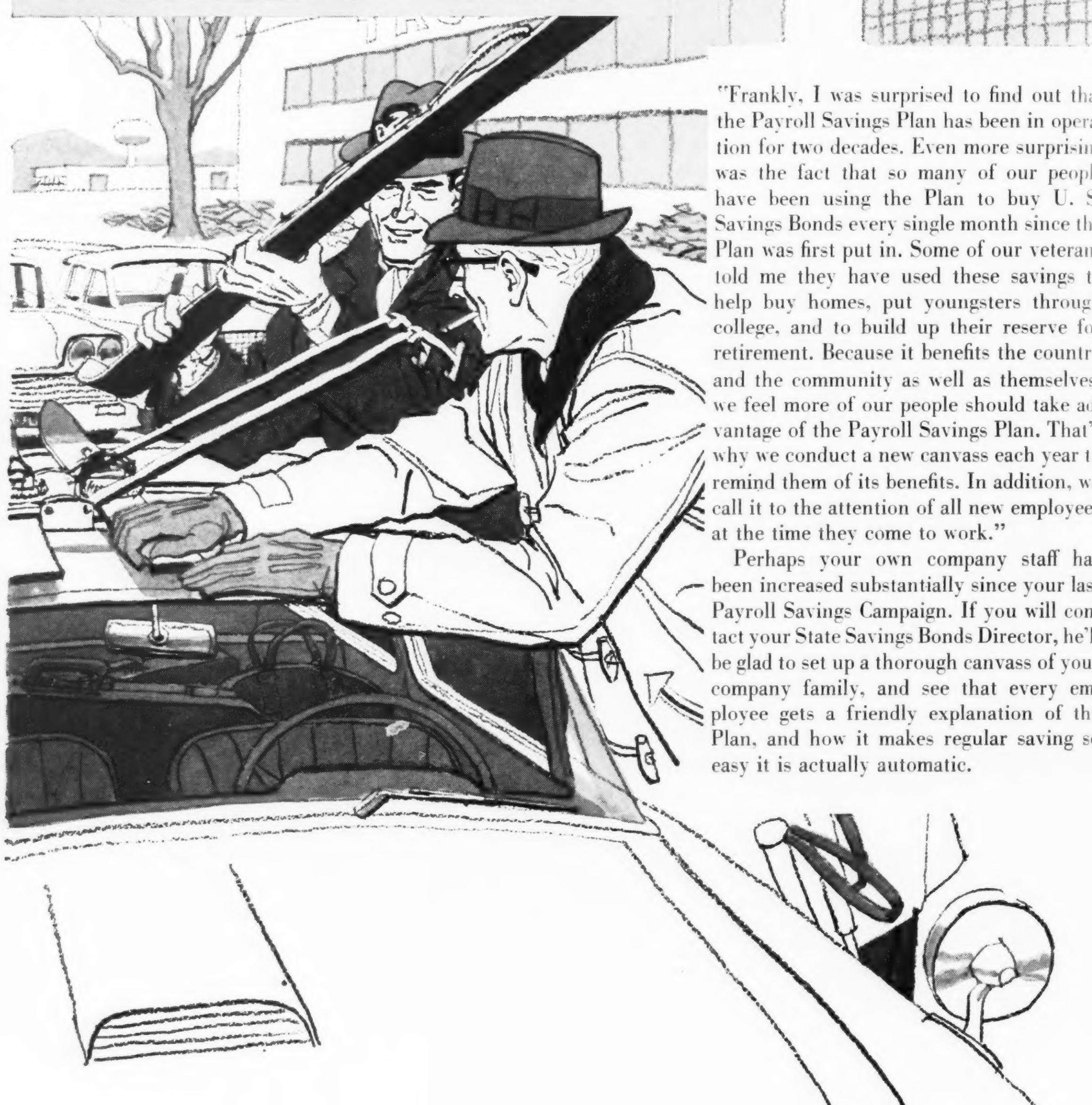

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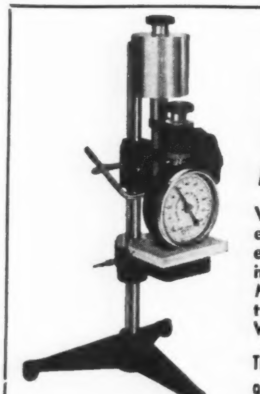

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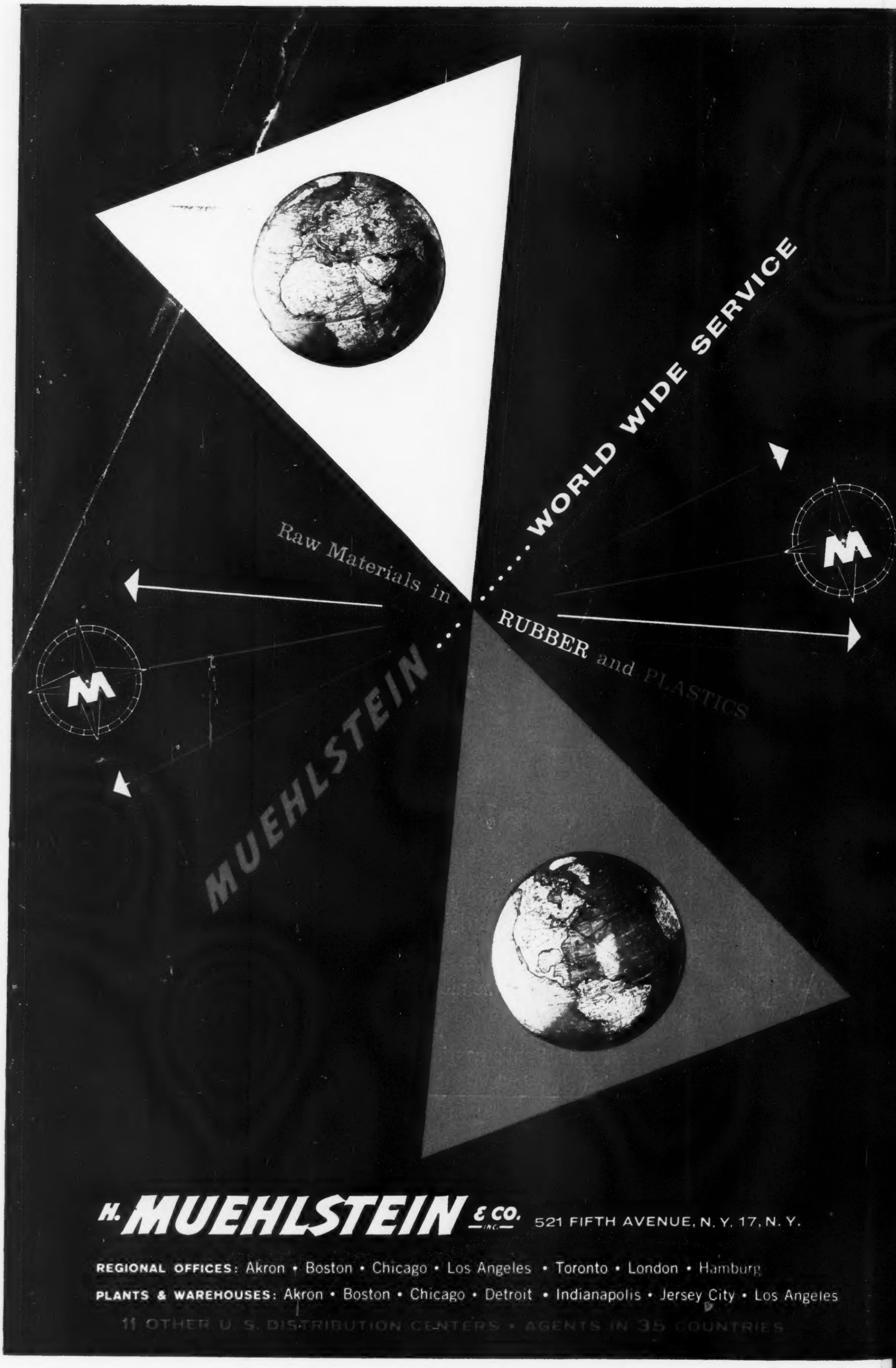
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